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ABSTRACT

A performance-based articulation program in data processing was developed between a secondary and postsecondary institution. Focus was on communication between secondary and postsecondary schools related to articulation needs, development of a common data base, and the identification of career options. The project had nine objectives, among which are the following: (1) to develop a system which eliminates the duplication of learned skills, (2) to identify program area articulation opportunities at the secondary and postsecondary levels, (3) to organize a performance-based instructional program for data processing where competencies are set for the secondary and postsecondary levels, (4) to construct the specific curriculum for each occupation within a program area through the use of task inventories, (5) to write instructional modules for each occupation within a program area, and (6) to develop criterion-referenced tests for each module. A project evaluation indicated that the objectives were accomplished and the two institutions made good progress toward articulation. (The appendix, comprising two-thirds of this report, contains the following: data processing competencies for computer programming, computer operations, and key punch operator; a program matrix and job mobility chart; a secondary and postsecondary course of study; a curriculum matrix for data processing; examples of three modules; a student progress checklist; and a task analysis guide.) (EM)

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FINAL REPORT

ARTICULATION PROGRAM BETWEEN SECONDARY AND POSTSECONDARY INSTITUTIONS IN COMPUTER TECHNOLOGY

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Project No. 55-77-111-3

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February 6, 1979

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U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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INFORMATION SHEET

A. Kind of Project: (check one)

1 ___	Experimental	4 X	Demonstration
2 ___	Developmental	5 ___	Evaluative
3 ___	Pilot	6 ___	Exemplary

B. Population

TYPE		NUMBERS (affected by project)
A	Disadvantaged	A ___
B	Handicapped	B ___
C	Migrant	C ___
D	Minority	D ___
E	Combination of the above	E ___
F	Other ✓	F 50-60

GROUP		
1	Pre-school	1 ___
2	Elementary	2 ___
3	Junior High School	3 ___
4	Middle School	4 ___
5	Senior High School	5 ___
6	Postsecondary	6 ___
7	Adult	7 ___
8	University	8 ___
9	Employer	9 ___
10	Employee	10 ___
11	Citizens	11 ___
12	Parents	12 ___
13	Combination of the above ✓	13 50-60

LOCALITY (check the one which encompasses the locality involved)

a	National	a ___
b	State	b ___
c	Region ✓	c 50-60
d	District	d ___
e	County	e ___
f	Area	f ___
g	Community	g ___
h	School Corporation (LEA)	h ___

I. ABSTRACT

The purpose of the project was to develop an articulation program between a secondary and postsecondary institution in data processing.

The project was to address the problems of 1) communication between secondary and postsecondary schools related to articulation needs, 2) development of a common data base, and 3) the identification of career options.

The one-year project alleviated and in most cases solved the majority of the problems addressed. The total evaluation will come later when students become more active as a part of the articulation program.

The instructional programs need to be measured by: placement and employer satisfaction with students on such a program, and involvement of business and industry in the educational process by helping identify job tasks.

The project has implications for those interested in curriculum development, instructional development, performance-based education, and vocational-technical education.

II. INTRODUCTION

Indiana Vocational Technical College of Central Indiana-Indianapolis Region 8, one-year grant project, Articulation Program Between Secondary and Postsecondary Institutions in Computer Technology, supported by the State Board of Vocational Technical Education, (SBVTE) addressed the area of articulation and performance-based education.

A performance-based curriculum does not differ from other curricula in its goals. The distinction of a performance-based curriculum is found in the assumptions that underlie it and in the approaches that characterize it. Performance may be defined as "the state of having requisite abilities or qualities." A curriculum is a set of designed courses or experiences. A performance-based curriculum then is one where the performances expected of all graduates are agreed upon and defined, and courses or experiences are designed to assist the student in becoming competent. If a curriculum is to have a performance-base, there must be a clear statement of both what the performances are and how a student may attain them.

A curriculum designed around performances consists of at least three basic elements: first, an overall statement of performances to be acquired for a successful completion of the program; second, sets of evaluative criteria and standards for each performance which define the scope and level of proficiency required for successful attainment; and third, sets of experiences designed to assist the student in attaining the required performances.

Advantages of Performance-Based Instructional Program

1. Instructional objectives are made clear to students, teachers, and the public.

2. Students' progress is monitored closely in relation to the stated objectives, especially in the early stages of learning to perform a task, and continuous diagnosis of difficulties and opportunities for remedial instruction are possible.

3. There is an opportunity for variation among learners with respect to the objectives they may pursue at a given time, the mode of instruction used, and the materials used for learning.

4. Time may be allowed to vary among students for the attainment of certain objectives, thus permitting slower students to take more time to reach the stated objectives and for faster students to proceed more quickly.

5. Different instructional goals may be set for different learners depending upon their occupational interests and abilities within the program area.

6. Emphasis is placed on the development of minimal levels of competency by all students in job tasks, thus promoting the acquisition by students of marketable job skills. Opportunity is provided for students to develop their competencies beyond minimal levels so they may optimally utilize their individual potential.

7. The relationship of identified competencies to job requirements is more easily depicted when the job itself has been the source of the task identification.

8. Opportunity is greater for variation within the instructional program, thus promoting the likelihood of meeting differing student interests, needs, and capabilities.

9. Students may play a larger role in selecting their instructional objectives in that they may specify particular occupational roles for which to prepare.

10. Students may be encouraged to assume more responsibility for their instructional progress when the completion of a program is dependent largely on the demonstration of specified competencies and greater latitude is permitted with respect to the means used to attain these competencies.

Disadvantages of Performance-Based Instructional Program

1. Performance-based instruction is dependent upon valid identification of tasks performed in entry-level occupations

and the availability of such task inventories to curriculum developers.

At the present time, task inventories of varying quality are available for many different occupations. V'Tecs is currently involved in collection of task inventories.

2. Some competencies desirable for certain occupations may be difficult to identify explicity from inventories of tasks performed.

3. Time may not be available for teachers to develop alternative instructional materials appropriate for learning the tasks which have been identified.

4. Several alternative testing instruments which are both valid and reliable measures of the instructional objectives may not be available.

   Alternative testing instruments are to be developed by the vocational instructors at the present time. It may be desirable at some point in time to make available to instructors the tasks, the objectives, and sample test items for occupational curriculum.

5. Unrestricted student-pacing of instruction may lead to an inefficient use of time by some students and, thus, may adversely affect the level of the number of competencies attained.

6. The identification of mastery levels of performance of occupational tasks, or minimum performance standards, is very difficult for many tasks.

7. The establishment of minimal performance levels for students may not provide sufficient encouragement for students to attain more advanced performance levels. (Burger and Lambrecht, 1974).

There are some assumptions which underlie any vocational instructional program. The literature has identified the assumptions that need to be understood by the persons involved in the project or other projects.

1. Students differ from one another in goals, aptitudes, abilities, needs motivations, aspirations, and job or career preferences.

2. The identification of the tasks performed in occupations is the initial step in developing efficient vocational education curriculum.

3. Occupational tasks can be identified.

4. The efficiency of learning can be increased by designating as flexible a sequence of occupational competencies as possible which will lead the student to his/her occupational goal and then allowing, where possible, the student to proceed through the sequence at his/her own rate.

5. Efficient progress of students toward occupational competencies may be facilitated by permitting student-pacing through segments of their instruction.

6. A curriculum must be defined in terms of its objectives as they apply to students.

7. Performance objectives identification must follow task identification in curriculum development. The existence of performance objectives then facilitates the development of evaluation instruments and the identification of learning activities appropriate to teach the objectives.

8. Time and personnel can be made available for the preparation of the necessary task inventories, instructional objectives, instructional materials development, and test development. (Block, 1970; Carroll and Spearitt, 1967).

Recent research in the area of testing has implications for the project. Criterion referenced or mastery testing has lead to an increasing awareness of the inadequacy of norm referenced testing for making decisions about individual mastery of subject matter (Durnin and Scandura, 1973: Popham, 1972).

Literature has also indicated that if instruction is specific and clear to the learner the learning session will strengthen motivation (Butler, 1972). Other research has indicated that if students master a subject or a set of performance objectives and the student receives objective and subjective evidence of the mastery, there are profound changes in how the student views learning.

One of the clearest evidence of affective change is the interest the student develops for the subject the student has mastered. (Bloom, 1976). Performance-based vocational programs can lead to a system of assisting students in mastering the subject area.

In summary, the research supports the development of articulation programs between secondary and postsecondary institutions.

In developing the articulation concept, the recommendation is to use a performance-based instructional format. This format can lead to alternative ways in which students might learn to perform the tasks necessary for the chosen occupations.

III. STATEMENT OF OBJECTIVES

Objectives of Project

The primary objective of the project is to develop an articulation program between an area vocational high school and a postsecondary institution in data processing.

A major enabling objective is to develop a performance-based instructional program in data processing using the V'Tecs materials as a resource for performance objectives.

The project's specific objectives are:

1. To develop a system which will eliminate the duplication of learned skills for secondary vocational students who desire the opportunity to enter the postsecondary school at an advanced level in the area of data processing.

2. To identify program area articulation opportunities at the secondary and postsecondary levels in the data processing occupations.

3. To organize a course of study at the area vocational high school for articulation with the postsecondary level.

4. To organize a performance-based instructional program for data processing where competencies are set for the secondary and postsecondary levels.

5. To construct the specific curriculum for each occupation within a program area through the use of task inventories.

6. To write instructional modules for each occupation within a program area.

7. To develop criterion referenced tests for each module.

8. To develop a record keeping system to monitor the progress of students through occupational instruction.

9. To develop criteria for updating and validating the articulation systems.

IV. STATEMENT OF THE PROBLEM

Statement of the Problem

The trend in programs today is to plan a more efficient means for students to go greater distances without encountering detours or delays in the educational process. Don Gentry, Executive Officer, Indiana State Board of Vocational and Technical Education, stated that secondary and postsecondary program articulation, planning, and coordination will enhance cooperative relationship and encourage all levels of instruction to join this effort of bringing about the best and most complete vocational education opportunities for all citizens in Indiana. Cooperation, coordination, and joint planning is encouraged between program levels and types.[1] Students find it difficult to have accepted what skills and knowledges they already know without some type of program between institutions.

Planned articulation programs between secondary and postsecondary institutions would help solve many of the current concerns between secondary and postsecondary vocational programs. Greater cooperation, coordination, and articulation between program levels are needed.[2]

The lack of instruction on other types of data processing equipment and the need for training beyond the secondary level would solve this problem for Blue River Vocational Technical Center data processing students as well as other area vocational high schools. The articulation of data processing programs between Blue River Vocational Technical Center and Indiana Vocational Technical College-Indianapolis would

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[1]The State of the State in Vocational Education by Don K. Gentry; presented to Indiana's Annual Vocational Education Conference, Indianapolis, Indiana; August 11, 1976. pp. 3-4.

[2]Ibid, p. 34.

assure the continuity and compatibility needed to make the transition from secondary level to postsecondary level to employment in the data processing industry.

The project aims to provide a system where competency levels are made clear to students, teachers, and the public. The project will develop written minimal and optimal levels of competency for students by job classifications, thus promoting the acquisition by students of marketable job skills.

The project will develop an articulation model program between an area vocational high school and a postsecondary institution to meet student needs and improve continuity and compatibility to provide competence in obtaining employment in the data processing industry.

Through employer reaction, recommendations made by the data processing advisory committee, and evaluations made by graduates, there is a constant response indicating familiarization and exposure with data processing equipment not available at Blue River Vocational Technical Center. Graduates and employers of data processing graduates strongly suggest the need for postsecondary training in order to achieve advancement and employment opportunities.

The final results of the project will assist other vocational educators in developing valid articulated vocational programs for secondary and postsecondary students.

In summary, the research supports the development of articulation programs between secondary and postsecondary institutions.

In developing the articulation concept, the recommendation is to use a performance-based instructional format. This format can lead to alternative ways in which students might learn to perform the tasks necessary for the chosen occupations.

V. PRIORITY AREA

Priority Area

The priority of the project was to develop a planned articulation program between a vocational secondary school and a postsecondary vocational school in data processing.

The program addresses the occupations that could be offered, the hierarchy of occupations in data processing, tasks inventories and curriculum development needed in specific areas of implementation.

VI. STRATEGIES

Procedures

The project will be carried out in seven basic steps. In summary the steps are:

1. List all of the occupations that culd be offered within a given program area;
2. Decide whether instruction for each listed occupation, within the program area, can be and will be offered in the local program;
3. Develop a Job Mobility Chart to show the basic hierarchy of occupations (beginning level to advanced level occupations) within the program area;
4. Organize the specific curriculum for each occupation within a program area through the use of task inventories;
5. Write instructional modules for each occupation within a program area; and
6. Develop a record keeping system to monitor the progress of students through occupational instruction.
7. Evaluation of the outcomes.

The first step toward the development of curriculum articulation for secondary and postsecondary institutions is to make a list of the occupations that could be offered within the program area. It is not necessary in making this first list to think in terms of certain occupations being taught at the secondary level and other occupations being taught at the postsecondary level; just make the list contain all the occupational titles that fall under the program area.

The second step toward articulation of secondary and postsecondary programs is for instructors from the area vocational secondary school and the postsecondary school to look at the list made is Step One and reduce it down to those occupations which (a) can be taught, (b) will be taught in the local program.

By making a listing of only those occupations which can be taught and will be taught in the local program, think about what is offered in the secondary and postsecondary institutions now. If only the title of the general offering appears, then identify some specific occupations (refer to the list you made in Step One) which are appropriate for students who have completed the general offering.

Next, a determination of what occupations are to be taught at only the postsecondary or only the secondary institutions and what occupations are to be offered at both the postsecondary and the secondary institutions. The actions suggested below will help as a guide:

1. Select all the occupations within each program area that will be collectively offered in the postsecondary school and at the secondary schools that contribute students to the postsecondary institution. Establish the list as though all occupations would be available at each institution.

2. Rely upon the task inventory to establish the content to be taught in each occupation. The instructors at both secondary and postsecondary levels will be able to communicate about the competencies needed by any person aspiring to a given occupational title.

3. Make as many copies as needed of the list made in Step One. Use one copy of the list to show occupations within the given program area that will be offered at each institution. Eliminate from the list those occupations which will not be offered at that institution because of one or more of the reasons below:

   A. Students will never have time to acquire the lengthy list of competencies needed for that occupation in the amount of time they can attend.

   B. Students at that level do not aspire to the occupation.

   C. Equipment, materials, and instructor time needed to teach the occupation is too expensive to warrant duplication of program offerings.

The third step toward curriculum articulation is the development of Job Mobility Chart.

Using the list of occupations that will be offered in the program area (from Step Two), make a Job Mobility Chart that shows which of

the occupations are prerequisite to other occupations, which are low level occupations, and which are higher level occupations.

Once the Job Mobility Chart is made, show it to the advisory committee and make the necessary modifications. The advisory committee members may need to review the task inventories for the occupations that appear on the chart so that everyone will have a common understanding of what tasks are performed by workers having various occupational titles.

The Job Mobility Chart helps instructors define various occupations in terms of beginning versus more advanced levels, which in turn has implications for which occupations may need to be offered at both secondary and postsecondary institutions. Also, the Job Mobility Chart, when shared with students, helps them understand the range of occupations within a program area. With this kind of information, a student is able to aspire to a more advanced-level occupation at the same time that he/she makes progress toward learning a beginning-level occupation.

The next step, Step Four, is to actually organize the curriculum for each occupation that appears on the list. The sections which follow suggest that the project personnel utilize the task inventories to decide: (a) which tasks for each occupation can be taught and will be taught in your program, (b) how to group those tasks into instructional modules for each occupation, and (c) how to sequence the instructional modules for each occupation within the entire program. All instructors will need to work together to make this outline so that articulation of occupations offered at the secondary and postsecondary institutions is realized.

There are four basic decisions which must be made as a person organizes the curriculum to be offered to students. They are:

Which occupational tasks are you going to teach for each occupation in the program? (These become the terminal performance objectives.)

What enabling objectives need to be included in the modules so that occupational tasks can be performed by students?

How should tasks be grouped into instructional modules?

What sequence of modules should you suggest to students? (Which module should be done first, second, third, etc.?)

Step Five is the development of modules for each occupation being taught at the secondary and postsecondary level.

A suggested format for each module is:

Purpose of Module
The Rationale
Competencies
Performance Objectives
The Learning Activities
Terminology
Assessment (Criterion Referenced Test)

After steps One through Five toward curriculum articulation have been developed, the next step is the development of a system for keeping track of students who are progressing through modules toward their occupational goals.

VII. ANALYSIS

The nine major grant components of the project are:

1. To develop a system which will elimnate the duplication of learned skills for secondary vocational students who desire the opportunity to enter the postsecondary school at an advanced level in the area of data processing.

2. To identify program area articulation opportunities at the secondary and postsecondary levels in the data processing occupations.

3. To organize a course of study at the area vocational high school for articulation with the postsecondary levels.

4. To organize a performance-based instructional program for data processing where competencies are set for the secondary and postsecondary levels.

5. To construct the specific curriculum for each occupation within a program area through the use of task inventories.

6. To write instructional modules for each occupation within a program area.

7. To develop criterion referenced tests for each module.

8. To develop a record keeping system to monitor the progress of students through occupational instruction.

9. To develop criteria for updating and validating the articulation system.

The above components were identified as areas of concern by the secondary and postsecondary institutions because of the following weaknesses:

1. A breakdown in communications between schools and programs because their concepts and terminology do not mean the same thing.

2. The inability to objectively or concretely communicate course content between programs because these programs have no common learning content data base upon which they have agreed.

3. The inability to provide continuity for specific career preparation between programs.

4. The lack of a learning content data base which is referenced in industry.

The major step in the development of the project was face to face meetings between secondary and postsecondary faculty. From the meetings, assignments were made and individual faculty did development work.

The review of the competencies by an advisory committee was also an important step. This step needs to be more thorough in any future projects.

VIII. FINDINGS

The objectives of the grant project which directly addressed the need and concerns already explained will be discussed in this section. The discussion will include the activities and outcomes relative to the objective, an assessment of the objective, followed by recommendation based on the experiences with the project.

Objective 1

To develop a system which will eliminate the duplication of learned skills for secondary vocational students who desire the opportunity to enter the postsecondary school at an advanced level in the area of data processing.

A. Activities and Outcomes

The following sequence of cooperative activities between secondary and postsecondary personnel were determined for implementing the articulated competencies to be taught at each level:

1. Each institution must reach agreement as to which competencies should be taught.
2. Determine which competencies should be taught as the secondary level and which competencies are to be taught as the postsecondary level.
3. Establish the advanced placement or credit granting procedures.
4. Develop and present the list of competencies for approval by secondary and postsecondary representatives.
5. Develop performance objectives for each competency.
6. Develop record keeping system at the secondary and postsecondary levels to record individual student progress.
7. Develop and implement a program of student counseling and student information material which explains the articulated program to students.

The project team consisting of the faculty member from the vocational secondary school and the faculty member from the postsecondary school developed the competencies from several sources. The sources were:

1. Vocational-Technical Education Consortium of States (V'Tecs). Task lists were available for Programmer Chief Business DOT 020168005, Programmer Business, DOT 020188026 and Data Processing Operations.

2. The Center of Vocational Education-Ohio State University Columbus, Ohio.

3. Suburban Hennepin County Area Vocational-Technical Centers, Minneapolis, Minnesota.

4. Kirkwood Community College, Cedar Rapids, Iowa.

5. Computer Program Curriculum at Indiana Vocational Technical College of Central Indiana.

6. Data Processing Curriculum at Blue River Area Vocational School.

See Appendix A for the task identification which indicates the tasks to be taught in the secondary and postsecondary programs.

The competencies were validated by an advisory committee review and reviewed by the faculty at both the secondary and postsecondary institutions.

B. Assessment

The objective seemed to have a complex beginning for the faculty who were not familiar with curriculum development and performance-based education, the frustration was alleviated by the assistance of Bill West, State V'Tecs Coordinator and Shirley Smalley of New Castle Community School Corporation. But this occurred late in the project which has caused problems in following the State Plan for Performance-Based Education. If the project staff had been more oriented toward the State plan at the beginning of the project, the results would be different.

C. Recommendations

The initial start-up research and orientation/in-service time must be provided on the State Plan for Performance-Based Education. An incorrect analysis because of inadequate project research and understanding at the onset of a project will cost much time and effort in the long run.

A more comprehensive work plan needs to be developed, communicated and followed.

The V'Tecs material was very useful, but needs to be reviewed and restated to meet program needs.

Objective II

To identify program area articulation opportunities at the secondary and postsecondary levels in the data processing occupations.

A. Activities and Outcomes

The first phase in the development of program area articulation opportunities at the secondary and postsecondary levels in data processing was to identify the occupations that could be offered within the data processing field.

A list of the occupations that could be offered within the program area of data processing was developed by the faculty members from each institution.

A list of occupations that are available in the data processing field are as follows:

Data Processing Industry

1. Data Processing Management
   Manager of Data Processing
   Assistant Manager of Data Processing

2. Systems Software Programming
   Manager or Supervisor of Systems Software Programming
   Systems Software Programmer

3. Systems Analysis and Design
   - Manager or Supervisor of Computer Systems Analysis and Design
   - Lead Computer Systems Analyst
   - Senior Computer Systems Analyst
   - Junior Computer Systems Analyst
   - Lead Computer Systems Analyst and Programmer
   - Senior Computer Systems Analyst and Programmer
   - Junior Computer Systems Analyst and Programmer

4. Computer Programming
   - Manager or Supervisor of Programming
   - Lead Computer Programmer
   - Senior Computer Programmer
   - Junior Computer Programmer
   - Computer Programmer Trainee

5. Computer Operations
   - JCL Technician
   - Manager or Supervisor of Computer Operations
   - Lead Computer Operator
   - Senior Computer Operator
   - Junior Computer Operator
   - Computer Input/Output Control Supervisor
   - Tape Librarian

6. Data Entry
   - Data Entry Supervisor
   - Lead Data Entry Operator
   - Senior Data Entry Operator
   - Junior Data Entry Operator

The second phase in the development of an articulated program between secondary and postsecondary in data processing was to review the list and identify only the occupations that could be taught.

Occupations that could be taught in the data processing field are:

1. Computer Programmer
   - Junior Computer Programmer
   - Computer Programmer Trainee

2. Computer Operations
   - Junior Computer Operator

3. Data Entry
   - Junior Data Entry Operator

At this point the question related to: What occupations are to be taught at the secondary level and what occupations are to be offered at both the secondary and postsecondary and what occupations are to be taught at only postsecondary?

The secondary school indicated offering the following programs:

Junior Data Entry Operator
Computer Operator
Fundamentals of Computer Programming

The postsecondary school indicated offering the following programs:

Junior Data Entry Operator-11 week program, Certificate of Proficiency
Computer Operator-33 week program, Technical Certificate
Computer Programmer-66 week program, Associate Degree

The competency lists for secondary and postsecondary have been identified in Appendix A for the above three occupations.

B. Assessment

The objective was successful in terms of identifying the jobs available. The survey sent to industry indicated a new job title that was not on the survey. The job title was JCL Technician (Job Control Language).

What is the cost effectiveness of Performance-Based Education? From the experience so far, it does not have to cost any more than regular instruction— and it may be more cost effective if more students can be accommodated in variable entry/exit classes.

According to the Indiana Plan for Performance-Based Education aimed at providing options for students, would be efficient in terms of time, energy, and dollars.

C. Recommendations

One problem that caused frustration was the curriculum development terminology. In other projects, the problems of terminology needs corrected by clearly defining and communicating to all involved. Both the process and the design plan need to be coordinated in an effective in-service program— either one-on-one or group.

Objective III

To organize a course of study at the area vocational high school for articulation with the postsecondary level.

A. Activities and Outcomes

Using the list of occupations that was developed by the faculty from the secondary and postsecondary schools, two items were developed:

1. The program matrix, and
2. The job mobility chart (see Appendix B)

The analysis of the charts indicate beginning level occupations and advanced occupations. The occupations being offered at this time are indicated as offered.

The programs not offered may represent new program areas or areas that required experience and more education.

The course of study at the secondary and postsecondary level is identified by a topical outline (see Appendix C).

The competencies for the various programs have been identified in Appendix A.

B. Assessment

The approach used is helpful for faculty and others to define the various occupations in a field of study and to determine relationships of the occupations.

If the information is shared with students, the charts can help in understanding the range of job opportunities related in a field. Students enroll in a program to prepare for employment and if options are understood in relation to job openings, students can make more informed judgements.

C. Recommendations

The involvement and utilization of advisory committees should be early in the project as such a committee will provide needed assistance.

A system needs to be develop to provide fllowup information on revising curricula as a result of technology changes.

Objective IV

To organize a performance-based instructional program for data processing where competencies are set for the secondary and postsecondary levels.

A. Activities and Outcomes

Competency lists the three occupations that were developed for data entry, computer operations and computer programmer. For each competency that appears on the competency list for each occupation, determination was made through faculty review and advisory committee review if the competency should be taught. The V'Tecs materials indicate if the majority of the programmers in the occupation perform the task.

The next question that needs answered is: Can and will the competency be taught? To answer this question you need to know:

1. Is equipment available or accessible?
2. Is the cost justified?
3. Are instructors available?
4. Where should the competency be taught, secondary or postsecondary or both?
5. How much time is required?
6. What prerequisites are necessary?

B. Assessment

This was a very difficult step because many of the task/competency lists had to be reviewed and rewritten to meet program needs.

C. Recommendations

Two areas that need more consideration in the development of a

performance-based program is student characterisitcs and the role of related and general education.

Objective V

To construct the specific curriculum for each occupation within a program area through the use of task inventories.

A. Activities and Outcomes

The first step in organizing a curriculum was to group related competencies together. In recent terminology this is a domain. Appendix A which indicates the competencies taught at the secondary and postsecondary level also reflect the grouping of competencies which are similar.

A program matrix which reflects the courses for each curriculum area is displayed in Appendix D.

B. Assessment

The procedure proved particularly beneficial with the faculty. The process required each faculty to evaluate the competencies and how each fit into the curriculum.

The faculty had to determine how the task was performed on the job, what prerequisite skills or knowledge were necessary, and what equipment was necessary in the performance of the task.

C. Recommendation

The refinement of the competencies must be done with full cooperation of the secondary and postsecondary institutions, as this is a very time consuming process.

Objective VI

To write instructional modules for each occupation within a program area.

A. Activities and Outcomes

The performance-based modules consisted of the purpose of the module, rationale, competencies, performance objectives, learning activities, terminology and assessment. See Appendix E for examples of the modules.

Along with the module development, an analysis of some tasks were accomplished.

B. Assessment

The procedure proved particularly useful for the instructor or for new instructors just beginning to teach data processing. Because of the late start on using the Indiana Plan for Performance-Based Education not all tasks have been analyzed properly. This can be done as continued development of the program progresses.

C. Recommendations

If schools are going to implement articulation programs, some policy are needed for awarding credit, advanced placement, and charging fees. Each program should be allowed flexibility based on its physical resources, number of materials and students, and type of instructors. But if previous competencies are identified and agreed upon, many problems will be resolved.

Objective VII

To develop criterion referenced tests for each module.

A. Activities and Outcomes

The criterion referenced test consisted mainly of post-assessment options for each unit (domain) and each module. For the most part, domains were developed using the criterion referenced testing plan. See Appendix E for examples of criterion referenced tests.

B. Assessment

For students who have had training in the secondary schools, the use of the tests can serve as a way to place students into advanced levels of the program. The test out option it is hoped will provide motivation for students who have skills in data processing. The model can also be used in other programs.

C. Recommendations

The criterion referenced tests that are developed need to be item analyzed and questions that are missed by students can serve as a review point for the instructional module.

Objective VIII

To develop a record keeping system to monitor the progress of students through occupational instruction.

A. Activities and Outcomes

The record keeping system is a method to record students' progress toward the occupational goals. One system which has been suggested is to computerize the student record keeping, or the performance-based educational system can record student progress by making appropriate checklists.

The system would record appropriate measure on a checklist each time a student completes a module or some other measure. In this project the module was used as the proficiency level.

Another record that may be recorded is the amount of time required to complete each module. This will provide data for computing the average amount of time it takes students to acquire various competencies.

The checklist the project faculty developed is displayed in Appendix F.

B. Assessment

The record keeping system used gets side tracked by personal preference.

The system suggested in this project is a compromise of several recommendations.

C. Recommendations

Policies should be developed on grading, because in most school systems the completion of competencies will eventually be converted to a letter grade.

If grades are to be assigned, they should be based on information related to the following:

1. The level of performance is higher than the minimum specified in the module objective(s) in terms of (a) the time taken to complete the activity called for in the outcome statement, (b) the number or proportion of successful attempts, and (c) the quality of the results that are considered acceptable.

2. The amount of time taken by the student to complete all of the modules in the instructional program is less than the amount of time required by the average student.

3. The high number of optional activities elected and completed by the student.

Objective IX

To develop criteria for updating and validating the articulation system.

A. Activities and Outcomes

The project team developed a design for studying the performance-based curriculum and the articulation process. The components of the evaluation are: students, the institution, the instructional program, the attainment of competence, and the administrative/organization climate.

The approach in updating and validating the articulation system using the described components will be descriptive. Variables that are easily understood will be utilized. Reporting and discussion will serve as a means of sensitizing faculty and administration at both the secondary and postsecondary level to articulation of programs.

The major questions to be explored under each component are identified as follows:

Students

1. How many students attend postsecondary institutions under an articulation program?
2. How many credits are students receiving under an articulated program?
3. How do the characteristics selected for study relate to other variables?
4. How do characteristics change for entering students as the performance-based curriculum becomes a part of the institution?
5. What differences emerge between students at the secondary and postesecondary institutions before the performance-based curriculum was introduced and the students on the program?

The following kinds of information will be gathered to answer the questions:

1. Background information
2. Student self-assessment scores
3. Enrollment data
4. Measures of cognitive and psychomotor development
5. Longitudinal studies

The Institution

1. What does the College look like as an institution?
2. What recruiting measures are used?
3. What is the total commitment to performance-based education?
4. What expertise does the institution have in performance-based education?
5. To what degree does the curriculum and the climate in which performance-based education occurs reflect the goals and objectives of the institutions?
6. What policies relate to performance-based education?

The following kinds of information will be gathered to answer these questions:

1. Instructional attitudes toward performance-based education.
2. What personnel would be committed to performance-based education?
3. Collection of critical incidents for both positive and negative reactions?

The Instructional Program

1. What are the intended outcomes of the instructional program?
2. What are the observed outcomes of instruction?
3. What unexpected outcomes occurred?
4. What are the possible and actual options available for students?
5. What are the strengths and weaknesses of the program?
6. What special faculty development programs do faculty need for perforamnce-based instruction.

The following kinds of information will be gathered:

1. Course syllabil, modules, objectives, evaluations criteria and standards will be developed, reviewed, and updated.
2. Course information material will be placed with both the secondary and postsecondary institutions for feedback from students, faculty and administration.
3. Formative evaluations will be suggested as a method for continuous evaluation.
4. The number and quality of instructional material will be evaluated.
5. Ratings by students.
6. Program evaluation.

The Attainment of Competence

1. What are entering levels of performance?
2. How much growth occurs toward performance with various learning experiences?
3. What levels of performance are attained by students?

4. How valid are performance measures compared to other appropriate critera?

5. How can the selection of minimum standards on performance measures be supported or justified?

The following kinds of information are to be planned and data gathered:

1. Test data for each module, course, etc.

2. Records of sequences and lengths of study and number of attempts to be evaluated as competent.

3. Case studies of students who are not successful and successful in achieving competence.

4. Analysis of measurement techniques to establish validity and reliability.

The Administrative/Organizational Climate

1. What day-to-day operations are required for performance-based education?

2. What management training is required for performance-based education?

3. What financial support is available toward the development and implementation of performance-based education?

4. What comprehensive planning procedures are needed for performance-based education?

The following kinds of information are to be planned and data gathered:

1. The identification of administrative activities related to performance-based education.

2. Survey administration to determine perceived needs.

3. Investigate the sources of funds for performance-based education.

4. Survey other schools involved in performance-based education to determine the problems, concerns, and strengths.

Objective X

To identify and visit an exemplary site that has developed performance-based educational programs.

A. Activities and Outcomes

The objective was not stated in the original proposal but is added here to be able to report a visit made to Suburban Hennepin County Area Vocational Technical Center and Normandale Community College, Minneapolis, Minnesota on December 1, 1978.

Suburban Hennepin Voc-Tech Center provided an interesting visitation in many respects. It was obvious that the State of Minnesota was committed to vocational-technical education, i.e., facilities, equipment, free tuition until 20 years of age.

1. Decentralized Learning Resource Areas - philosophically provide Hennepin students ease of access to video, audio, and printed materials for supplementing their educational programs and possibly providing learning alternatives. An excellent cross-section of books, magazines, and media was seen in a shared health/business area. A non-teaching person was provided to assist students. No students were seen utilizing this facility nor were students within any related programs questioned as to its usage.

2. An individualized format was the primary instructional method, varying by program. It appeared to function very well, and I was particularly impressed with the students' level of maturity in such a system. They appeared to be seriously involved in their educational pursuit. A greater exposure to this would provide a better basis for judgment. The concept of manager of learning came through, but many managers appeared to be under-utilizing available resources.

   The uniform procedure used for the instructional development, called learning paks are as follows:

   a. An occupational description.
   b. Occupational competencies.
   c. Program blocking.
   d. Task listing sheet.
   e. Task detailing sheet.
   f. Student characteristic sheet.
   g. General and specific performance objectives.
   h. Evaluation for performance objectives.

3. Staff Development - Special facilities and personnel were provided to assist staff while administratively, instructional staff used two hours a day plus two weeks each year to work on program improvements under an MBO program. Three video taping crews were available for concentrated development as well as other media to support personnel.

4. Variable Entry - Was defined as program entry more than once per year and each program determined how this would occur. It should be noted that single person entry was not a positive aspect for certain programs. Each program or cluster area needs to carefully study what variable entry should mean.

All programs run 12 months a year serving both secondary and post-secondary students. All programs shut-down for a two-week period during the year so that faculty may spend time on curriculum development.

The second college visited was Normandale Community College which is a two-year public community college with programs in liberal arts, pre-professional and occupational programs.

The Individualized Competence Based Education (ICBE) program is an individually tailored, student-designed program leading to the Associate in Arts Degree for transfer to selected upper division institutions. The ICBE program is designed (1) for students desiring an alternative form for their education, (2) for students desiring assessment of experiential learning for credit equivalence, and (3) for students needing non-traditional learning resources or opportunities not ordinarily in the curriculum. The largest areas of student interest have been in the areas of human services, business and liberal studies. (The program is not recommended for those planning to enter pre-law, engineering, pre-med, technical sciences, architecture or for teacher certification.)

The unique qualities of the ICBE program are as follows:

a. Flexible educational programs enabling students to use the varied learning resources available in the community, educational institutions, business, government agencies, and others.
b. Opportunities to present non-college learning to be evaluated for credit equivalence, e.g. military schooling, on-the-job training, seminars, professional development, civic competence, and self-generated learning.
c. Individualized, student-designed degree plans.
d. Expression of the knowledge and accomplishments of the student in narrative terms as competence statements. (A traditional transcript giving titles and credits is also available.)

IX. EVALUATION

The secondary and postsecondary faculty and administrators served as critique and review personnel.

A number of factors were examined during the year to determine the success of the project, such as the development of task lists, cooperation of faculty, effectiveness of the process and procedures. The main evaluation technique was comparing stated objectives against results.

The overall evaluation of the projects indicates the objectives were accomplished.

The procedures and process have been well defined for any future projects. The evaluation indicates that objective six was not developed to the quantity that was desired.

The evaluation also indicates some weaknesses in the use of the Indiana State Plan for Performance-Based Education. This has been previously pointed out because of late understanding by the faculty and project staff as to the plan.

The in-service training needed early in the project was not accomplished which also caused some problems with the project.

In the future an evaluation plan will consist of the following components:

1. The effectiveness of the process and procedures in terms of implementing and conducting the curricula.
2. The study of the performance-based curriculum development by survey results from students, instructors and administration.
3. Effects of performance-based curriculum upon student enrollment, student retention and student placement.
4. Effects of performance-based curriculum upon employer and student satisfaction in the employment place.

X. CONCLUSIONS AND RECOMMENDATIONS

Project analysis and direction must not be slighted at the beginning of the project because the resulting information will be crucial in providing direction for the duration of the project. Decision makers and key participants need to be identified and their commitment secured at the onset of the project.

A project plan needs to be developed that is relevant to the project goals and setting and which includes a functional communication network, a development procedure, and a timeline of tasks. Based on reliable feedback and formative evaluation techniques, the plan should be refined and/or revised as the project continues.

When developing performance-based education curriculum, obtain and review existing sources of competencies and employment trends. Then actively involve an advisory committee as they will be able to provide more relevant information on curriculum/employment needs in the occupation.

If a competency survey is going to be utilized to validate the competencies, a computerized system for analysis and reporting is the most efficient.

Frustration about how, who, and what to do next, can be alleviated through an active, organized project orientation which clearly and concisely communicates the process model and tasks involved to the project staff.

Faculty support as well as budgetary support must be available to adequately develop curriculum in the performance-based format.

An assessment or evaluation procedure which assists in ascertaining project results, outcomes and products should be devised early in the project and followed in order to provide data for accurate revision and refinement of the activities.

The two institutions made good progress towards articulation but the following areas need additional development:

1. Content identification and test development.
2. Field testing the articulation plan.
3. Performance-based curriculum development in new job titles.

The recommendations from the project are related to two areas: problems of implementation and critical elements.

1. Problem of implementation
   a. A task force should be appointed from each institution involved in an articulation program to formulate overall objectives and a plan for achieving and implementing the program.

   b. Effective design and implementation of performance-based curricula involves the use of a wider range of instructional materials than required by more traditional programs. Faculty will also need program materials oriented toward varying student abilities and backgrounds. Such materials must be developed for they are seldom available in a form usable by faculty in a given program. This means that faculty must have the time to develop such resources and the financial support to secure the needed materials. Such demands must be anticipated.

   c. The performance demands placed on students in a performance-based curriculum differ from the demands of a more traditional program. Acceptable (or competent) work means precisely that. Progress up to the proficiency level marked as competent is necessary but unacceptable for purposes of certification. Students must be led to think in terms of competency and not semester averages or group norms. Evaluation is individual and criterion referenced under a performance-based curriculum and students tend to underestimate the importance of immediate attention to performance levels. Hence, unless students are well prepared for a performance-based curriculum, much friction tends to develop as a result of the unrealistic expectations they bring to the program deriving from past educational experiences.

   d. There is a tendency in a performance-based curriculum to think of student performance in terms of either competent or incompetent and to neglect detailed and specific feedback to students as to their areas of strength and weakness. In order to combat this tendency, extensive diagnostic assessment and feedback prior to and during any given

curricular program must be undertaken. Students can improve their proficiency only as they become aware of the nature of their deficiencies. Effective diagnostic instruments must be devised and administered and students effectively counseled as to their progress. Otherwise, an unnecessarily rigid and misunderstood system of requirements emerges which benefits neither students nor faculty.

e. An immediate problem emerges when a performance-based curriculum is initiated and student progress toward competency does not keep pace with the established course offerings. Students who need further work in a given area must be handled. This means a grading (or record) system must be devised which allows for individual progress but also respects faculty time and energy.

f. Many student competencies can be assessed in limited course experiences or by appropriate single test measuring procedures. However, some competencies will take time to develop and students will need continued feeback on their progress toward those competencies. Longitudinal evaluation structures are necessary.

g. It is advisable to allow adequate lead time in order to experiment with evaluation criteria and instructional designs in the movement toward performance-based programs. Otherwise, much dissatisfaction may arise from unrealistic evaluation criteria or unmanageable instructional experiences. Such lead time in experimentation will also provide the necessary data for identifying reasonable time expectations in which students can be moved successfully toward competency.

2. Critical Elements

a. Entrance into the establishment of a full performance-based curriculum takes a strong commitment on the part of the administration at both secondary and postsecondary institutes to provide the leadership necessary to see the program through. This leadership must have both a long-range vision and an ability to engage in an extended process of institutional development without losing the vision. It also takes key faculty who are willing to give the time and energy to sustain a long-term project and who can be led to share the vision. These faculty leaders must be capable of motivating others as well as learning themselves. Such endeavors take money for released time for faculty, consultants, and particularly for a person to oversee the program who understands the concept.

b. A radical change in the reward system--one which will provide more than a pat on the back for those who commit themselves to the program--is essential. Faculty must be convinced that the administration views this change as a major one and one for which rewards are available for efforts at both the change to and maintenance of a new curricular concept.

c. Implementation of a performance-based curriculum requires faith to take initial steps without seeing clearly the concrete forms of final results. The implementation of a performance-based curriculum is a process which secures changes in faculty self-perceptions and the teaching models utilized. This is a long-range development with the results being genuine change in the design of daily learning experiences and not just in course or curricular labels. But such change is not brought about immediately or easily. It involves the change of persons and their professional attitudes.

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XI. FINANCIAL STATEMENT

See financial statement prepared by Executive Headquarters.

XII. SUPPLEMENTAL AND APPENDIX

Appendix	Title
A	Data Processing Competencies
B	Program Matrix and Job Mobility Chart
C	Course of Study Secondary and Postsecondary
D	Curriculum Matrix for Data Processing
E	Examples of Modules
F	Student Progress Checklist Examples
G	Task Analysis Guide

APPENDIX A

DATA PROCESSING COMPETENCIES

DATA PROCESSING COMPETENCIES

COMPUTER PROGRAMMING TECHNOLOGY

DATA PROCESSING COMPETENCIES

COMPETENCIES WHICH HAVE BEEN IDENTIFIED	V'TECS COMPETENCIES WHICH RELATE
01 - Data Processing Fundamentals	
*1. Trace the history of the development of data processing.	
*2. Describe data processing career paths, duties, and responsibilities.	
*3. Describe similarities and differences between types of data processing systems.	
*4. Describe the operations and functions of the principle input and output devices.	
*5. Interpret punch card code.	
*6. Interpret EBCDIC Coding system.	
*7. Interpret hexadecimal coding system	Convert numbers manually from one number system to another.
*8. Operate an interactive terminal or computer.	
*9. Operate a batch terminal.	
*10. Operate data entry equipment.	
*11. Identify a Cobol, Fortran, PL/I, RPG, and ALC programs. (Secondary does not do ALC)	
*12. Describe the use of program flowcharts and elementary programming logic in solving a programming problems.	

* - Taught at both secondary and postsecondary
** - Taught at postsecondary
*** - Taught at secondary

DATA PROCESSING COMPETENCIES

COMPETENCIES WHICH HAVE BEEN IDENTIFIED	V'TECS COMPETENCIES WHICH RELATE
*02 - Programming Skills and Techniques	B1 - Apply computer installation guidelines during analysis.
	B2 - Apply organization guidelines during analysis.
	B4 - Consult technical references during analysis.
	B6 - Determine input format for job.
	B7 - Determine machine format for input.
	B8 - Determine machine format for output.
	B9 - Determine output format for job.
	B11 - Examine existing utility programs for application to a job.
	D1 - Adapt programs to process on different computer configurations.
02 - 1 Assembler Language	D9 - Code programs incorporating standard routines.
	D17 - Prepare program routines.
**1. Identify assembler language characteristics.	
**2. Identify assembler language rules.	
**3. Create a logic flowchart to analyze a problem using assembler language.	
**4. Generate Assembler Source Program.	
*5. Transform assembler language code to machine readable form.	
**6. Desk check source programs prior to assembly.	E8 - Desk check source programs for keypunching errors prior to assembly or compilation.
**7. Assemble program.	

DATA PROCESSING COMPETENCIES

COMPETENCIES WHICH HAVE BEEN IDENTIFIED	V'TECS COMPETENCIES WHICH RELATE
**8. Determine errors in assembly source listing.	E9 - Desk check source program listing after assembly or compilation.
**9. Debug program and make corrections.	E6 - Debug programs.
**10. Devise and run tests on simulated data to check out program changes and corrections that ensure desirable effects in the program.	A12 - Evaluate program test results.
	A22 - Review completed programs for accuracy.
	E1 - Analyze computer input for test run.
	E2 - Anayize computer output following test run.
	E4 - Analyze program processing efficiency during test run.
	E5 - Correct programming errors discovered during testing.
	E7 - Design test data for use in program testing.
	E10 - Recommend solutions to undesirable conditions discovered during tests.
	E11 - Test programs for accuracy.
	E12 - Test programs for efficiency.
	E13 - Test programs for flexibility.

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COMPETENCIES WHICH HAVE BEEN IDENTIFIED	V'TECS COMPETENCIES WHICH RELATE
**11. Document a program by appropriate commentary, input-output definition, program listings, test data, methodology, and special features.	A10 - Evaluate program documentation for correct procedures. A24 - Review documentation of programs. F2 - Develop documentation narrative. F3 - Develop listing of all programs. F5 - Prepare console operator's run books with necessary instructions and messages. F8 - Write definition of input. F9 - Write definition of output.
02 - 2 Cobol Language	D9 - Code programs incorporating standard routines. D17 - Prepare program routines.
*1. Identify cobol language characteristics.	
*2. Identify cobol language rules.	
*3. Apply file management techniques.	
*4. Create a logic flowchart to analyze a problem for the cobol language.	
*5. Generate cobol source program.	
*6. Transform cobol program to machine readable form.	
*7. Desk check.	E8 - Desk check source programs for keypunching errors prior to assembly or compilation.
*8. Compile cobol program.	

DATA PROCESSING COMPETENCIES

COMPETENCIES WHICH HAVE BEEN IDENTIFIED	V'TECS COMPETENCIES WHICH RELATE
*9. Determine errors in cobol source listing and make corrections.	E9 - Desk check source program listing after assembly or compilation. E6 - Debug programs.
*10. Devise and run tests on simulated data to check out program changes and corrections that ensure desirable effects in the program.	A12 - Evaluate program test results. A22 - Review completed programs for accuracy. E1 - Analyze computer input for test run. E2 - Analyze computer output following test run. E4 - Analyze program processing efficiency during test run. E5 - Correct programming errors discovered during testing. E7 - Design test data for use in program testing. E10 - Recommend solutions to undesirable conditions discovered during tests. E11 - Test programs for accuracy. E12 - Test programs for efficiency. E13 - Test programs for flexibility.
*11. Document a program by appropriate commentary, input-output definition program listings, test data, methodology, and special features.	A10 - Evaluate program documentation for correct procedures. A24 - Review documentation of programs. F2 - Develop documentation narrative.
**12. Generate cobol programs using structured design and techniques.	F3 - Develop listing of all programs. F5 - Prepare console operator's run books with necessary instructions and messages.

DATA PROCESSING COMPETENCIES

COMPETENCIES WHICH HAVE BEEN IDENTIFIED	V'TECS COMPETENCIES WHICH RELATE
	F8 - Write definition of input.
	F9 - Write definition of output.
*02 - 3 RPG-II Language	D2 - Code computer applications using a utility report program generator.
	D9 - Code programs incorporating standard routines.
	D17 - Prepare program routines.
**1. Identify RPG-II language characteristics.	
*2. Identify RPG-II language rules.	
*3. Apply file management techniques.	
**4. Create a logic flowchart to analyze a problem for the RPG-II language.	
**5. Generate RPG-II code program.	
**6. Transform RPG-II program to machine readable form.	
**7. Desk check.	E8 - Desk check source programs for keypunching errors prior to assembly or compilation.
**8. Compile RPG-II program.	
**9. Determine errors in RPG-II source listing.	E9 - Desk check source program listing after assembly or compilation.
	E6 - Debug programs.

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DATA PROCESSING COMPETENCIES

COMPETENCIES WHICH HAVE BEEN IDENTIFIED	V'TECS COMPETENCIES WHICH RELATE
**10. Devise and run tests on simulated data to check out program changes and corrections that ensure desirable effects in the program.	A12 - Evaluate program test results. A22 - Review completed programs for accuracy. E1 - Analyze computer input for test run. E2 - Analyze computer output following test run. E4 - Analyze program processing efficiency during test run. E5 - Correct programming errors discovered during testing. E7 - Design test data for use in program testing. E10 - Recommend solutions to undesirable conditions discovered during tests. E11 - Test programs for accuracy. E12 - Test programs for efficiency. E13 - Test programs for flexibility.
**11. Document a program by appropriate commentary, input-output definition program listings, test data, methodology, and special features.	A10 - Evaluate program documentation for correct procedures. A24 - Review documentation of programs. F2 - Develop documentation narrative. F3 - Develop listing of all programs. F5 - Prepare consoleoperator's run books with necessary instructions and messages. F8 - Write definition of input. F9 - Write definition of output.

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DATA PROCESSING COMPETENCIES

COMPETENCIES WHICH HAVE BEEN IDENTIFIED	V'TECS COMPETENCIES WHICH RELATE
*03 - Utilization of Programming and Debugging Techniques	D15 - Determine how data records are to be processed.
**1. Utilize data base organization.	D3 - Code data-base update programs.
*2. Utilize sequential access method.	
*3. Utilize indexed sequential access method.	
*4. Utilize random access method.	
*5. Utilize virtual storage access method.	
*6. Utilize blocking.	
*7. Utilize checksumming, hashing and parity.	
*8. Utilize packing and unpacking.	
*9. Utilize sequential search.	
*10. Utilize binary search.	
*11. Utilize existing sort/merge programs with control cards.	D7 - Code programs for inquiry device.
*12. Utilize modular organization of a program and its data.	
*13. Utilize table driven program and data driven program.	
*14. Utilize programmed switches.	
**15. Utilize structured coding.	
*16. Utilize table look up for finding function values.	
*17. Utilize packed decimal arithmetic.	

DATA PROCESSING COMPETENCIES

COMPETENCIES WHICH HAVE BEEN IDENTIFIED	V'TECS COMPETENCIES WHICH RELATE
**18. Utilize mode conversion rules and mixed mode arithmetic.	
**19. Utilize error returns from subroutines.	
*20. Utilize traces, snapshots, and diagnostic messages.	E15 - Utilize memory maps in testing.
**21. Utilize cross-reference table, memory and file dumps.	E3 - Analyze core dumps.
*22. Code and develop subroutines.	D11 - Code subroutines. D16 - Develop subroutines.
*23. Correct program when problem occurs.	G3 - Correct program when "Blow Up" occurs.
*24. Update existing programs with changes.	G9 - Update existing programs with changes.

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DATA PROCESSING COMPETENCIES

COMPETENCIES WHICH HAVE BEEN IDENTIFIED	V'TECS COMPETENCIES WHICH RELATE
04 - Problem Solving Techniques and Concepts	
*1. Identify flowchart symbols and tools.	
*2. Prepare detailed flowcharts from general flowcharts and program specifications.	C5 - Prepare detail flowchart. A23 - Review detail flowcharts for preparation of programs.
**3. Identify decision table concepts.	
**4. Prepare decision tables from general flowcharts and program specifications.	
*5. Identify and apply JCL requirements.	F4 - Develop program job control statements.
*6. Determine logic sequence of programs.	C1 - Detail all specified calculations.
*7. Prepare systems flowchart.	C7 - Prepare systems flowchart.
*8. Prepare input/output operations flowchart for machine operators.	C6 - Prepare input/output operations flowchart for machine operators.

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DATA PROCESSING COMPETENCIES

COMPETENCIES WHICH HAVE BEEN IDENTIFIED	V'TECS COMPETENCIES WHICH RELATE
05 - Advanced Data Processing Concepts	
*1. Describe type of data communications system.	
*2. Describe advantages and disadvantages of data communications systems.	
*3. Describe data communications applications.	
**4. Design a data communications network.	
**5. Identify data base management components and functions.	
*6. Identify information systems analysis concepts.	
*7. Analyze and design forms.	B5 - Design record layouts.
*8. Identify card-tape-disk operating systems.	
**9. Identify virtual storage and virtual memory concepts.	
*10. Demonstrate detailed systems investigation and analysis techniques.	
*11. Evaluate system efficiency, effectiveness and cost.	
**12. Use various scheduling technique as PERT and CPM.	

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DATA PROCESSING COMPETENCIES

COMPUTER OPERATIONS

COMPETENCIES WHICH HAVE BEEN IDENTIFIED

01 - Supervising Data Service

**1. Analyze company operations for beneficial use of the computer.

**2. Analyze data processed for modification and/or combination reports.

*3. Analyze functional area reports for error correction.

**4. Assist in planning facility modification.

**5. Assist with data processing facility staffing.

**6. Consult with supervisors concerning problem areas.

**7. Coordinate activities with data control unit.

**8. Determine destruction dates of computer files.

*9. Handle special requests for data processing services.

**10. Update training records for data services personnel.

*11. Make periodic checks to clarify correctness of output.

**12. Monitor compliance with machine utilization log procedures.

*13. Monitor the meeting of deadlines.

**14. Notify appropriate person or office of new or revised reporting requirements.

**15. Orient newly assigned data service personnel.

**16. Plan and schedule routine data services work assignments.

**17. Prepare correspondence concerning data services.

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* - Taught at both secondary and postsecondary
** - Taught at postsecondary
*** - Taught at secondary

COMPETENCIES WHICH HAVE BEEN IDENTIFIED

02 - Supervising Automatic Data Processing Operations

*1. Assign priorities to computer jobs.

***2. Brief oncoming shift supervisor.

**3. Coordinate scheduling of machine work load.

*4. Determine cause of faulty output.

*5. Develop computer operating instructions.

**6. Maintain operating manuals and directives affecting machine room functions.

**7. Maintain records of machine performance.

**8. Monitor jobs processed and pending.

**9. Orient new operators to basic services offered by the data processing center.

***10. Conduct on-the-job training in equipment operations.

*11. Instruct new operators in the use of operations manuals.

03 - Performing Data Control Functions

**1. Analyze data processed to make sure that desired information is obtained.

***2. Analyze documentation for completeness and accuracy.

***3. Arrange reruns to correct final output.

***4. Balance output data.

***5. Check error with appropriate staff and arrange for correction.

***6. Control basic input into data processing system.

COMPETENCIES WHICH HAVE BEEN IDENTIFIED

***7. Coordinate functions of data control with operations.

***8. Distribute printed output to users.

**9. Develop procedures relative to computer input and output.

***10. Maintain files pertaining to data systems.

***11. Plan card layouts.

***12. Code input data for computer entry.

***13. Provide input on jobs to operations unit.

***14. Release jobs for processing.

***15. Schedule keypunching.

***16. Screen cards for errors and initiate corrections.

***17. Store cards that have been removed from machine.

***18. Train personnel in methods of handling output.

04 - Preparing for Computer Processing Operations

***1. Clear memory on computer.

*2. Determine the availability of the peripheral devices needed for a specific job.

*3. Determine the forms needed for job.

*4. Determine priority of jobs to be run on the computer.

*5. Determine steps in running a job.

*6. Determine type of information needed to run a job.

**7. Locate tapes in storage.

COMPETENCIES WHICH HAVE BEEN IDENTIFIED

*8. Power up computer and I/O devices.

***9. Receive turnover on jobs from another shift.

**10. Schedule peripheral devices to be used for jobs.

05 - Operating Electronic Computers

*1. Activate reader to read job into the system.

06 - Preparing for Computer Processing Operations

*1. Check JCL to see that it corresponds to the job to be run.

07 - Operating Electronic Computers

*1. Check output material to determine that work is complete.

*2. Catalog card input.

*3. Communicate with the computer through the console.

*4. Determine cause of incorrect output.

*5. Determine cause of a machine malfunction.

*6. Initialize disk pack.

**7. Initialize tape.

*8. Load the supervisor.

*9. Interpret display lights on computer.

*10. Load JCL cards and input data into reader.

*11. Load programs.

*12. Make necessary changes in JCL cards.

09

COMPETENCIES WHICH HAVE BEEN IDENTIFIED

*13. Observe for abnormal termination of job.

*14. Observe for faulty output.

*15. Observe for verification printouts which indicate end of job or job steps.

*16. Perform halt/restart procedures.

*17. Reload the supervisor.

*18. Remove JCL cards from job deck.

***19. Remove output from machine.

*20. Run test of new program for systems/programming.

***21. Set control switches on central processor.

***22. Set load unit address.

***23. Use a sort-merge utility program to sort cards.

*24. Utilize operator's manuals.

*25. Utilize utility program.

08 - Operating Computer Peripheral Equipment

*1. Assign disk drives to appropriate logical address.

*2. Determine proper forms for printer.

*3. Determine carriage tape needed to control spacing/skipping of printer.

*4. Load cards into card reader or card punch.

***5. Load continuous forms in printer.

***6. Load paper tape on paper tape reader.

COMPETENCIES WHICH HAVE BEEN IDENTIFIED

***7. Operate card reader or card punch.

***8. Operate disk drive.

***9. Perform peripheral conversion operations.

***10. Place carriage control tape in printer.

**11. Punch carriage tapes to control skipping and spacing of forms.

***12. Adjust print density.

09 - Operating Unit Record Equipment

*1. Correct cards on the keypunch.

*2. Keypunch cards from source documents.

***3. Load card hopper.

***4. Mount program card on drum of keypunch machine.

***5. Operate interpreter to print data on punched cards.

***6. Operate reproducer to gangpunch cards.

*7. Operate reproducer to reproduce cards.

***8. Operate sorter for alphabetic sorting.

***9. Operate sorter for numeric sorting.

***10. Operate sorter to select specified cards.

***11. Punch Program card for keypunching from source document.

*12. Reproduce cards on the keypunch.

***13. Select specified wired control panel for use.

COMPETENCIES WHICH HAVE BEEN IDENTIFIED

*14. Set up keypunch machine for punching cards.

***15. Verify cards to check accuracy of keypunching.

*16. Visually interpret punched cards.

***17. Wire interpreter control panel.

***18. Wire reproducer control panel.

010 - Maintaining Equipment and Records

***1. Clear card jams.

**2. Cut tape and position new load point marker.

**3. Handle service calls on equipment.

*4. Maintain card files for JCL cards.

*5. Maintain computer log.

*6. Maintain files on procedural changes.

*7. Perform routine housekeeping duties.

*8. Perform routine operator maintenance on machines.

*9. Place cards, tape, or disk packs in storage.

***10. Prepare external labels for cataloging files.

***11. Separate printed output forms using decoilator.

DATA PROCESSING COMPETENCIES

KEY PUNCH OPERATOR

COMPETENCIES WHICH HAVE BEEN IDENTIFIED

01 - Key Device

*1. Recognize a data recording problem as it pertains to key device equipment and progam the equipment satisfactorily to meet the recording problem.

*2. Identify the care, functions, and operations of the key device and verifying equipment.

*3. Develop skill through progressively difficult practice exercises and simulated business data recording problems.

*4. Comprehend and use articulately the commonly used data processing terms associated with key device equipment.

*5. Demonstrate specified standards of speed and accuracy on key device equipment which will enable the student to gain entry-level employment.

***6. Develop keypunch verification sheet.

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* - Taught at both secondary and postsecondary
** - Taught at postsecondary
*** - Taught at secondary

GENERAL AND RELATED COMPETENCIES

FOR

COMPUTER PROGRAMMING TECHNOLOGY

DATA PROCESSING COMPETENCIES

COMPETENCIES WHICH HAVE BEEN IDENTIFIED	V'TECS COMPETENCIES WHICH RELATE
06 - Human Relations And Supervisory Skills	
1. Demonstrate effective listing.	
2. Demonstrate gentle and precise questioning.	
3. Accept responsibility for own mistakes.	
4. Demonstrate ability to work as a team member with praise and criticism being given to the team rather than to the individual.	A13 - Function as part of a team to solve user problems in information processing.
5. Demonstrate initiative and persistence to accomplish assignments.	
6. Apply realistic goal setting.	
7. Interact with customer and user personnel to establish programming requirements and data flows.	
8. Consult with programming associates to determine detailed design and to discuss required data designs and program flows.	
9. Consult with colleaques or supervisors for the purpose of acquiring technical programming guidance or system knowledge.	
10. Demonstrate adaptability to various tasks and situations.	
11. Consult with operations on adequate preparation of computer operating instructions.	A2 - Consult with operations on adequate preparation of computer operating instructions.
12. Consult with system designers on programming requirements of new systems.	A3 - Consult with systems designers on programming requirements of new system(s).

DATA PROCESSING COMPETENCIES

COMPETENCIES WHICH HAVE BEEN IDENTIFIED	V'TECS COMPETENCIES WHICH RELATE
13. Recommend modification of systems to management.	A20 - Recommend modification of systems to management.
14. Recommend modification of systems to users.	A21 - Recommend modifications of systems to users.
15. Review programs for adherence to programming standards.	A25 - Review programs for adherence to programming standards.

07 - Mathematics

1. Add, subtract, multiply and divide whole numbers.
2. Add, subtract, multiply and divide common fractions (including mixed numbers).
3. Add, subtract, multiply and divide decimal numbers.
4. Convert fractions to decimals.
5. Convert decimals to fractions.
6. Simplify arithmetic expressions involving addition and/or subtraction and/or multiplication and/or division using the proper order for all operations.
7. Write and simplify ratios.
8. Change a percent to a decimal or fraction.
9. Change a decimal or fraction to a percent.
10. Solve percentage, base, rate problems for any one of the three.
11. Add, subtract, multiply and divide signed numbers.
12. Raise a number to a positive whole number power or a negative whole number power.
13. Find the square root of a positive number.
14. Perform fundamental operations using powers of ten.
15. Perform fundamental operations using scientific notation.
16. Read instruments (gauges and meters).
17. Use the rules of measurement (accuracy, precisim) to properly round off answers to arithmetic problems.
18. Use the English system of measurement.
19. Use the metric system of measurement.

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20. Convert measurements from one unit to another within each system and between the English and metric systems.

21. Evaluate algebraic expressions.

22. Add, subtract, multiply and divide single term algebraic expressions.

23. Simplify expressions involving grouping symbols (parentheses, brackets, braces).

24. Add, subtract, multiply and divide polynomial algebraic expressions.

25. Solve non-fractional linear equations in one unknown.

26. Solve work problems using non-fractional linear equations.

27. Use formulas to solve for an unknown.

28. Graph a linear equation in two unknowns.

29. Solve two equations/two unknown problems by graphing, addition-subtraction method and substitution method.

30. Solve word problems using two equations and two unknowns.

31. Understand binary, octal and hexadecimal number systems.

32. Add, subtract and multiply binary numbers.

33. Add and subtract octal and hexadecimal numbers.

34. Use set notation to describe well-defined sets.

35. Combine sets using union and intersection.

36. Find complement and subsets of a given set.

37. Define common symbols used in flowcharting.

38. Given a verbal or written description, construct a flowchart.

39. Given a problem in set notation, construct a flowchart.

40. Write truth tables using and, or, negation, if-then, if-and-only-if.

41 Given a truth table, construct a flowchart.

42. Simplify using the summation ( ) symbal.

43. Organize data using charts, tables, graphs (bar, line, circle) and listograms.

44. Find mean, median and mode of ungrouped data.

45. Find mean, median and modal class of grouped data.

46. Find standard deviation for ungrouped and grouped data.

47. Change a ran score to a score.

48. Find the value of a combination.

49. Find the value of a per

50. Define and use the term probability.

51. Write a

52. Define a normal distribution and its characteristics.

53. Use the normal distribution to approximate a

54. Use hypotheses testing to evaluate sample data.

COMPETENCIES WHICH HAVE BEEN IDENTIFIED

08 - Communication Skills

1. Apply the convention of English grammar, usage and styles.
2. Apply the convention of punctuation and spelling.
3. Demonstrate reading comprehension skills.
4. Interpret data in a graphic aid.
5. Write a letter of application.
6. Write resume.
7. Prepare visual and graphic aids.
8. Compose routine informational communications.
9. Compose concilliatory communications.
10. Compose negative (bad news) communications.
11. Compose persuasive communications.
12. Apply the principles of effective reporting.
13. Compose memos.
14. Assess own communicative image.
15. Deliver an informative oral presentation.
16. Conduct an oral training presentation.
17. Deliver a persuasive oral presentation.
18. Apply principles of effective conference communications.
19. Apply principles of effective communications in interviews.

COMPETENCIES WHICH HAVE BEEN IDENTIFIED

20. Demonstrate comprehension of verbal and non-verbal communication.

21. Demonstrate active listening skills.

DATA PROCESSING COMPETENCIES

COMPETENCIES WHICH HAVE BEEN IDENTIFIED	V'TECS COMPETENCIES WHICH RELATE
09 - Accounting Skills	
1. Construct a balance sheet.	
2. Journalize transactions.	
3. Prepare income statement, balance sheet, and capital statement.	
4. Prepare closing entries.	
5. Journalize special journals and post to ledgers.	
6. Make adjusting entries, journalize, and post.	
7. Complete the worksheet, make closing entries, and take postclosing trial balance.	
8. Make reversing entries.	
9. Prepare individual income tax returns.	
10. Determine audit objective and opinions.	
11. Complete a payroll journal including the calculation of amounts of federal income tax, state income tax, and social security tax to be withheld.	
12. Record the expenses and liabilities arising from (a) weekly payroll disbursements, including the required monthly deposit of income and FICA taxes in the bank, (b) computation of the amount of state unemployment tax for a quarterly period.	

COMPETENCIES WHICH HAVE BEEN IDENTIFIED	V'TECS COMPETENCIES WHICH RELATE
13. Prepare required general journal entries to record the receipt of cash and other necessary readjustments to partnership investment accounts when a new partner is admitted to a partnership firm.	
14. Analyze and make the required entries for these transactions in a voucher register/check register accounting system.	
15. Complete the gross tax due, the commission, and the net tax payable on the retail sales.	
16. Complete an income statement for a three-department firm and determine the departmental and total gross profit, contribution margin, and the net profit from operations.	
17. Record the giving of an interest-bearing note payable in general journal form.	
18. Record the discounting of a interest-bearing note receivable in general journal form.	
19. Record the dishonor of note receivable.	
20. Record the removal of contingent liabilities in general journal form.	
21. Compute all interest charges applicable to note receivable transactions.	

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DATA PROCESSING COMPETENCIES

COMPETENCIES WHICH HAVE BEEN IDENTIFIED	V'TECS COMPETENCIES WHICH RELATE
10 - Business Principles	
1. Analyze the economic, political, and social environment of business.	
2. Determine whether an enterprise is a proprietorship, a partnership, or a corporation.	
3. Classify business enterprises according to the types of activities performed.	
4. Compare the economic system of the United States with that of the Soviet Union.	
5. Evaluate the government's role in relation to business.	
6. Analyze how government influences and controls private business activities.	
7. Evaluate the effects of antitrust legislation.	
8. Illustrate horizontal, vertical, and conglomerate mergers.	
9. Analyze the profit motive as a basic characteristic of the private enterprise system.	
10. Determine factors that influence the ability of a business to make a profit.	
11. Analyze the cyclical nature of our economy.	
12. Evaluate the various risks that can affect business operations.	
13. Analyze the causes of business failures.	

COMPETENCIES WHICH HAVE BEEN IDENTIFIED	V'TECS COMPETENCIES WHICH RELATE
14. Analyze the role of management from a systems point of view.	
15. Visualize the relationship of the various subsystems to the total business system.	
16. Evaluate the benefits of good management of the activities in the business enterprise.	
17. Evaluate both sides of staffing a business organization.	
18. Analyze the importance of the planning function.	
19. Determine the relationship of authority and responsibility as applied to the business enterprise.	
20. Recognize that the budget is not only a guide to future events but also a control mechanism.	
21. Construct a cash budget for a fictitious company when given the necessary information.	
22. Evaluate the usefulness of a break-even chart for analyzing profits.	
23. Evaluate the effects of organized labor in the operation of the business enterprise.	
24. Analyze the economic status of certain minority groups and their relationships with businesses especially in matters of employment and enterprise ownership.	
25. Compare why business managers base marketing decisions on the behavior of consumers.	

COMPETENCIES WHICH HAVE BEEN IDENTIFIED

V'TECS COMPETENCIES WHICH RELATE

26. Evaluate the effects of consumer protection legislation on business enterprises and on the consumer.

27. Appraise the four variables comprising the marketing mix--product, promotion, price, and place, and how they focus on the consumer.

28. Analyze the stages in the typical product development program.

29. Compare the principal methods of promotional activities--personal selling, advertising, and sales promotion.

30. Evaluate the factors that give time and place to products.

31. Analyze the elements of the production system which include research and product design, process design, production control, purchasing, and sutomation.

32. Evaluate the importance of location of production facilities.

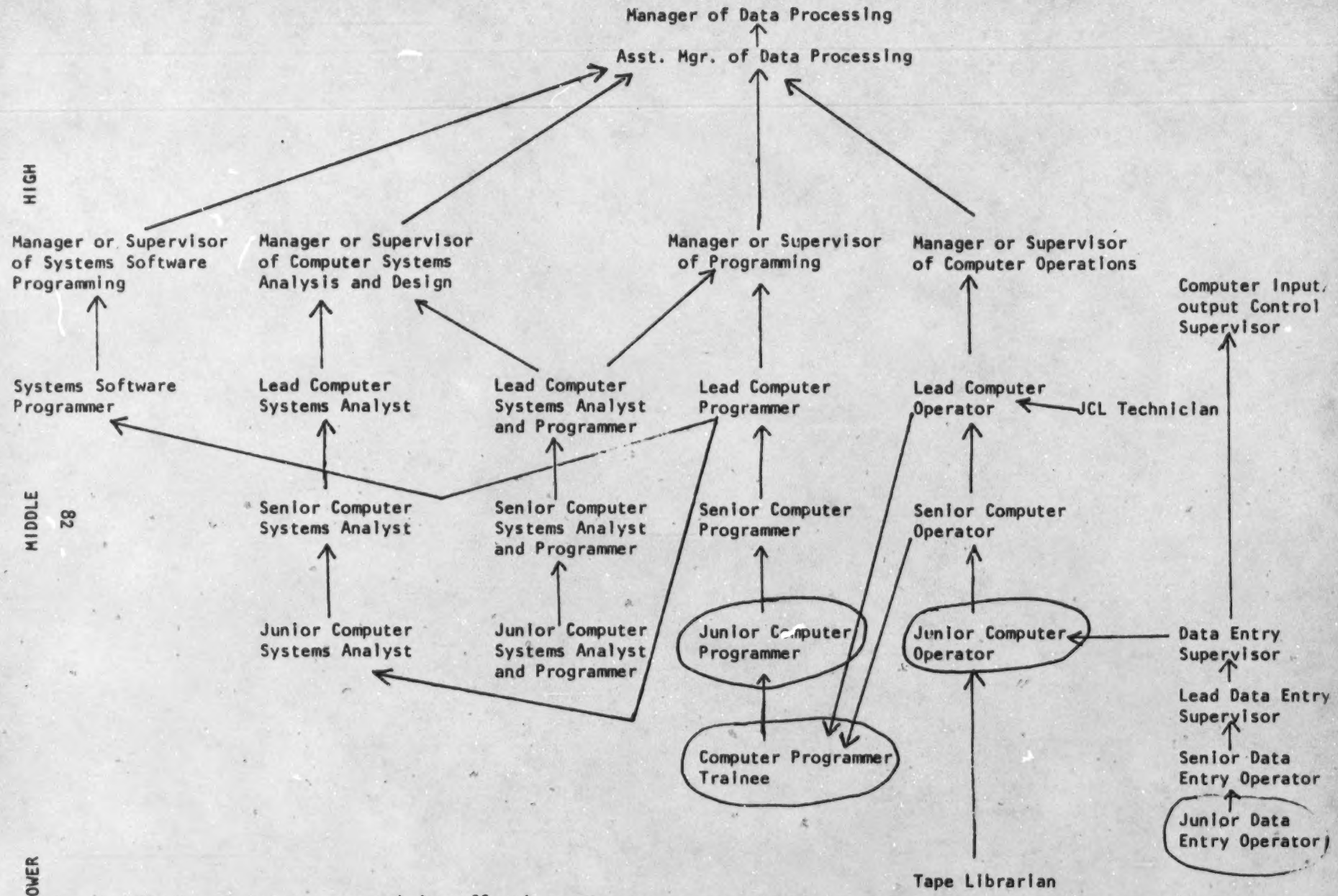
33. List major considerations faced by management in the location of new manufacturing facilities for six industries.

APPENDIX B

PROGRAM MATRIX AND JOB MOBILITY CHART

SUB CLUSTER	CATEGORY	JOB TITLE	TASK	CATEGORY CORE	SUB CLUSTER CORE	CLUSTER CORE
80 DATA PROCESSING	Data Processing Management	Manager of Data Processing	Task inventories available for each job title	Tasks common to Data Processing Management Category	Tasks common to Data Processing Sub Cluster	Tasks common to Data Processing Cluster Core
		Asst. Manager of Data Processing				
	Systems Software Programming	Manager or Supervisor of Systems Software Programming	Task inventories available for each job title	Tasks common to systems sofware programming category		
		Systems Software Programmer				
	Systems Analysis and Design	Manager or Supervisor of Computer Systems Analysis and Design	Task inventories available for each job title	Tasks common to systems analysis and design		
		Lead Computer Systems Analyst				
		Senior Computer Systems Analyst				
		Junior Computer Systems Analyst				
		Lead Computer Systems Analyst and Programmer				
		Senior Computer Systems Analyst and Programmer				
		Junior Computer Systems Analyst and Programmer				

SUB CLUSTER	CATEGORY	JOB TITLE	TASK	CATEGORY CORE	SUB CLUSTER CORE	CLUSTER CORE
DATA PROCESSING	Computer Programming	Manager or Supervisor of Programming	Task inventories available for each job title	Tasks common to computer programming category	Tasks Common to Data Processing Sub Cluster	
		Lead Computer Programmer				
		Senior Computer Programmer				
		Junior Computer Programmer				
		Computer Programmer Trainee				
	Computer Operations	JCL Technician	Task inventories available for each job title	Tasks common to computer operations category		
		Manager or Supervisor of Computer Operations				
		Lead Computer Operator				
		Senior Computer Operator				
		Junior Computer Operator				
		Computer Input/Output Control Supervisor				
		Tape Librarian				
	Data Entry	Data Entry Supervisor	Task inventories available for each job title	Tasks common to Data Entry Category		
		Lead Data Entry Operator				
		Senior Data Entry Operator				
		Junior Data Entry Operator				



Circle represent programs being offered.

JOB MOBILITY CHART

APPENDIX C

COURSE OF STUDY SECONDARY AND POSTSECONDARY

BLUE RIVER AREA VOCATIONAL PROGRAM

FIRST YEAR STUDENTS - DATA PROCESSING COURSE OUTLINE

INTRODUCTION

- Instructor
- Orientation to school
- Course requirements
- Meaning of Data Processing

CAREERS IN DATA PROCESSING

- Types of jobs available
- Education necesary
- Skills necesary
- Salaries
- Advancement

SAFETY

- Operator considerations
- Equipment considerations

BASIC USE OF KEYPUNCH EQUIPMENT

- Keypunches
  - Numeric and non-numeric representation
  - Documentation
  - Card layout
  - Card fields
  - Program cards
  - Program levels
- Verifiers

BASIC FLOW CHARTING

- Keypunching job

BASIC USE OF CARD SORTING EQUIPMENT

- Numeric sorting
- How machines read cards
- Alphabetic sorting
- Documentation
- Shortcuts
  - Block sorting

BASIC USE OF FORMS HANDLING EQUIPMENT

- Decollator
- Burster

BASIC USE OF UNIT - RECORD EQUIPMENT

- Functional keys and switches
- Equipment capabilities
  - Types of input
  - Types of output
  - Turnaround documents
- Wiring principals
  - Types of hubs
  - Wiring similarities
  - Wiring differences

OPEN HOUSE PLANNING

INTRODUCTION TO COMPUTER

- Capabilities
- How it recognizes data
- File descriptions
- Power up and power down
- Program
  - System
  - Application
- How to run a program

COBOL PROGRAMMING

- Flowchart
- Rules
- Writing
- Compiling
- Testing
- Documenting
- Application

BLUE RIVER AREA VOCATIONAL PROGRAM

SECOND YEAR STUDENTS - DATA PROCESSING COURSE OUTLINE

INTRODUCTION

- Course requirements
- Review first year accomplishments

BASIC DISK CONCEPTS

- Physical description
  - Operational areas
  - System areas
- Organization
  - Surface
  - Tracks
  - Cylinders
  - Sectors
- Principals of magnetic recording
- Controllers
- File Organization
- File Access
  - Direct (Random)
  - Serially
- Data formats
  - Unpacked
  - Packed numeric
  - Binary

TABLE CONCEPTS

- Definitions
- Accessing
- Building

DISK SORT

- Major/minor fields
- New file creation
- File specifications worksheet
- Execution

SAFETY

- Operator considerations
- Equipment considerations

DOCUMENTATION

- Flowcharting - Review
  - Reasons for
  - Symbols and meanings
  - Techniques

- Other types of documentation
  - Input/output organization
  - Report layout
  - Documenting programs
    - Remarks included with source program
    - Written narrative
  - Instruction manuals

SYSTEM DESIGN - LIVE PROJECTS

- Project assignment
  - Team concept vs. individual
- Starting point - the end results
- Flowchart system
- Input data needed
- Designing operator input entry
  - Adapt to existing input forms
  - Turn around documents
  - New input forms
- Designing disk files
  - Chained files
  - Sequential files
- Design programs
  - Utilize manufacturer's utility programs
    - Disk sort, file copy, file delete
  - Flowchart user programs
    - Write user programs
      - Set-up test data
      - Test programs
- System verification
  - Input
  - Programs
  - Report requirements
  - Recovery
- System automation
  - Build control strings
- Documentation
  - System
  - Input
  - Programs
  - Output
- Application
  - System utilization by designer(s)
  - System utilization by others

OPEN HOUSE PLANNING

OPERATING SYSTEMS

- Philosophy and elements
- Functions
- Multiprocessing, multiprogramming, time sharing

PROGRAMMING LANGUAGES

- Assembler and macro-instructions
- Fortran
- RPG
- PL/1
- ALGOL
- NEAT/3

CURRENT DEVELOPMENTS OF DATA PROCESSING IN INDUSTRY

- Oneline entry
- Methods of inputing data
  - Laser beam
  - Voice
  - Cards
  - Cassette
  - Magnetic tape
  - Floppy disk
  - Key-to-disk
  - Magnetic strip
  - Optical scanner

TWO TYPES OF COMPUTERS

- Digital
- Analog

COMPUTER PROGRAMMING TECHNOLOGY
Associate in Applied Science

QUARTER I							**C**	**L**	**P**	**CR**
0510	Introduction to Data Processing or						3	4	0	5
0511	Introduction to Programming						3	4	0	5
0323	Business Principles and Organization						3	0	0	3
	Mathematics Elective						4	0	0	4
8110	Communications						4	0	0	4
										16
QUARTER II										
0520	Cobol Programming I						3	4	0	5
0521	Computer Operations						3	4	0	5
0522	Problem Solving Techniques						3	0	0	3
8402	Applied Psychology or						4	0	0	4
8401	Human Relations						4	0	0	4
										17
QUARTER III										
0530	Cobol Programming II						3	4	0	5
0531	Operating Systems						3	4	0	5
0110	Accounting Principles	3	2	0	4	or	4	0	0	4
8113	Oral Communications						4	0	0	4
										18
QUARTER IV										
0540	Systems Analysis and Design	2	4	0	4	or	3	2	0	4
8210	Statistics						3	0	0	4
0120	Accounting Principles II	3	2	0	4	or	4	0	0	4
	Computer Programming Elective						3	4	0	5
										16
QUARTER V										
0551	Business Programming Applications						3	4	0	5
8111	Business Communications						4	0	0	4
	Business Elective									4
	Computer Programming Electives									5
										18
QUARTER VI										
0560	Data Communications						4	0	0	4
8501	Field Study/Coop Ed						0	0	18	6
	Computer Programming Elective									5
	Elective									3
										18

Total Credits: 103

ELECTIVES/REGIONAL OPTIONS		C	L	P	CR
	Any Communication Courses				
	Any Mathematics and Science Courses				
8501	Field Study/Coop Ed	0	0	3-29	1-9
	Any Business Division Courses; and				
0570	Assembler Language Programming I	3	4	0	5
0576	Assembler Language Programming II	3	4	0	5
0572	Fortran Programming	3	4	0	5
0573	RPG Programming	3	4	0	5
0574	PL/1 Programming I	3	4	0	5
0575	Topics in Data Processing I	3	4	0	5
0577	Topics in Data Processing II	3	4	0	5
0571	Introduction to Data Processing (non-majors)	2	2	0	3
0578	Practicum	0	2-6	0	1-3

APPENDIX D

CURRICULUM MATRIX FOR DATA PROCESSING

COURSE/OPTION MIX

5101 DATA PROCESSING TECHNOLOGIES

PROGRAM COMPOSITION	CREDITS	OPTIONS		
		Computer Programming (AAS/103)	Data Processing Operation (TC/45)	Key Device Operations (OC/15)
0510 Introduction to Data Processing or	5	X	X	X
0511 Introduction to Programming	5	X		
0323 Business Principles and Organization	3	X	X	X
Mathematics Elective	4	X	X	
8110 Communications	4	X	X	
0520 COBOL Programming I	5	X		
0521 Computer Operations	5	X	X	
0522 Problem Solving Techniques	3	X	X	
8402 Applied Psychology or 8401 Human Relations	4	X	X	
0530 COBOL Programming II	5	X		
0531 Operating	5	X		
0110 Accounting Principles I	4	X	X	X
8113 Oral Communications	4	X		
0540 Systems Analysis and Design	4	X		
8210 Statistics	3	X		
0120 Accounting Principles II	4	X		
Computer Programming Elective	5	X	X	
Business Division Elective	3/4	X	X	
0551 Business Programming Appls.	5	X		
8111 Business Communications	4	X		
Computer Programming Elects.	5	X	X	
0560 Data Communications	4	X		
8501 Field Study/Coop Ed	6	X		
Computer Programming Elects.	5	X		
1233 Key Device Training	4			X
1238 Adv. Key Device Training	4			
1236 Office Calculating Machines	3			
1212 Typewriting I				
0567 Operations Techniques	5			

COURSE/OPTION MIX

5101 DATA PROCESSING TECHNOLOGIES

ELECTIVES/REGIONAL OPTIONS	CREDITS	OPTIONS		
		Computer Programming (AAS/103)	Data Processing Operation (TC/45)	Key Device Operations (OC/15)
Any Math and Science course	2			
Any Communication courses	2			
8501 Field Study/Coop Ed	1-9			
Any Business Division course				
0570 Assembler Language Programming I	5			
0571 Introduction to Data Processing (non-majors)	3			
0572 Fortran Programming	5			
0573 RPG Programming	5			
0574 PL/I Programming I	5			
0575 Topics in Data Processing I	5			
0576 Assembler Language Programming II	5			
0577 Topics in Data Processing II	5			
0578 Practicum	1-3			

APPENDIX E

EXAMPLES OF MODULES

DATA PROCESSING

01 - DATA PROCESSING FUNDAMENTALS

MODULE NAMES

01-1 Overview and History of Data Processing
01-2 Computer Hardware
01-3 Computer Programming

02 - PROGRAMMING SKILLS AND TECHNIQUES

02-1 - ASSEMBLER LANGUAGE

MODULE NAMES

02-1-1 Fundamentals and Characteristics of Assemble Language
02-1-2 The Instruction Set
02-1-3 Addressing Concepts
02-1-4 Dump and Debugging
02-1-5 Writing Assembler Programs
Using External Table Logic
02-1-6 Introduction to Direct Access File Processing

02-2 - COBOL LANGUAGE

MODULE NAMES

02-2-1 Fundamental and Characteristics of Cobol Language
02-2-2 Components of Cobol Language
02-2-3 Identification of Environment Division
02-2-4 Data Division
02-2-5 Procedures Division
02-2-6 Writing Basin I/O Cobol Programs
02-2-7 Writing Cobol Programs
Utilizing Storage not Defined in I/O Files
02-2-8 Writing Cobol Programs
Utilizing Control Break Logic
02-2-9 Writing Cobol Programs
Utilizing Table Hookup Logic
02-2-10 Writing Cobol Programs
Utilizing Sequential File Processing
02-2-11 Writing Cobol Programs
Utilizing Random File Processing
02-2-12 Utilize Report Writer and the Cobol Sort

02-3 - RPG LANGUAGE

MODULE NAMES

02-3-1 RPG Concepts
02-3-2 I/O Processing
02-3-3 Arithmetic Operations
02-3-4 Editing
02-3-5 Comparing
02-3-6 Control Break Logic
02-3-7 Field Record Relutions, Multiple Records Types, Look Ahead, and Exception Output
02-3-8 Table Handling
02-3-9 Magnetic File Processing

DOMAIN NAME 01 DATA PROCESSING FUNDAMENTALS

MODULE NAMES

01-1 Overview and History of Data Processing
01-2 Computer Hardware
01-3 Computer Programming

PURPOSE OF DOMAIN

To introduce the learner to the basic terms and concepts of the Data Processing industry. Most topics are covered briefly, with in-depth coverage dealt with in follow-up courses in each area. The material is prerequisite to the language courses.

DOMAIN 01 DATA PROCESSING FUNDAMENTALS

MODULE NAME 01-1 OVERVIEW AND HISTORY OF DATA PROCESSING

PURPOSE OF MODULE

To acquaint you with the scope, history and opportunities of the data processing industry, and to present the most basic vocabulary terms.

RATIONALE

Most people have very little idea of what data processing is, or what kinds of things they will be learning in the data processing department. This section serves as an orientation to the industry and to the data processing programs.

COMPETENCIES

1. Understand the scope of the data processing industry and explain the relationships between the various subfields in the industry.
2. Describe the duties, briefly, of the different job titles in the data processing industry.
3. Converse about the history of data processing knowledgeably.
4. Correctly use the terms in this module.

PERFORMANCE OBJECTIVES

1. Given the basic terms, from memory correctly write the definitions for them.
2. Given a diagram showing the subfields in data processing, from memory correctly draw lines showing the relationships involved. No more than one of the relationships may be wrong.
3. Given a list of job titles and a list of duties, match each duty with the primary job title which encompasses that duty.
4. Given a list of job titles, place them in one of three salary groups: low, medium, high.
5. Write definitions or descriptions of the terms and names used in this module.
6. Rank events in data processing history.

LEARNING ACTIVITIES

1. Participate in the instructor's presentation(s) which will include the following subject content: data processing industry—scope, courses at Ivy Tech-Indianapolis, basic definitions.
2. View an introductory film on data processing.
3. Read the introductory chapter or chapters in the text.
4. Write answers to questions on a worksheet.
5. Participate in the instructor's presentation on job titles and duties.
6. Read the handout on the latest salary survey. Presentation will include the following: job descriptions in simple terms ranging from data control clerk to corporate director of data processing.
7. Read the chapters in the text on data processing history.
8. Participate in the instructor's presentation on data processing history.
9. Fill out a work sheet using the terms and names of this module.

MATERIALS s MEDIA

1. Copy of the latest salary survey from Datamation Magazine.
2. Handout showing jobs and salary ranges.
3. Worksheets with terms and definitions to match.

TERMINOLOGY

data processing
data
information
system
computer
programming
operations
systems analysis
character
field
record
file
data base
CPU
hardware
software
scientific data processing
business data processing
input
output

TERMINOLOGY (continued)

I/O
data entry
operations on single numbers
    arith +, -, ÷, X
    compare two numbers
operations with groups (files/records)
    store and retrieve
    copy/transmit
    change
    sort
    merge
director of data processing
development programmer
maintenance programmer
business programmer
scientific or engineering programmer
systems programmer
lead systems analyst
programmer trainee
systems analyst trainee
operations manager
lead computer operator
keypunch operator
data entry clerk
data control clerk
disk/tape librarian
abacus
Napier's bones
Pascal's calculator
Leibniz
Jacquard loom
Babbage
Hollerith
punched card systems
differential analyzer
Mark I computer
mechanical calculators
accounting machines
ENIAC
IBM 650
first, second, third, fourth generation computers
electronic calculators
programmable calculators
stored program computers
Atanasoff
Antikythera device
slide rule
Tabulating Machine Company
IBM
Burroughs

SELF-TEST

MODULE 01-1 OVERVIEW AND HISTORY OF DATA PROCESSING

1. Define the following terms related to the overview and history of data processing:

   programming
   systems analysis
   data base
   software
   business data processing
   lead computer operator
   punched card systems
   development programmer
   data control clerk
   disk/tape librarian

2. Given the following data processing job titles; Match correctly all job titles to duty and salary group.

   Lead computer operator
   Lead systems analyst
   Director of data processing
   Operations manager
   Key punch operator

3. Given the following historical events in data processing, the student will rank the events in chronological order.

   First generation computer
   Abacus
   Hollerith code
   Virtual storage
   Mark I
   IBM 650

DOMAIN 01 DATA PROCESSING FUNDAMENTALS

MODULE NAME 01-2 COMPUTER HARDWARE

PURPOSE OF MODULE

The present computer revolution is based on the computing machines which do data processing. With a basic understanding of how this computer hardware works, you can better understand many of the computer-related changes taking place in our society today.

RATIONALE

You must see how the various parts of the computer hardware fit together in order to understand how they combine to produce useful work in the form of data processing. This section explains at a very basic level what each of the various hardware components does and how they are related and are interconnected to each other.

COMPETENCIES

1. Use the names of the hardware components correctly.
2. Describe what kinds of information are stored in memory, how they are stored, and the correct terms for transferring information into and out of memory.
3. Describe the use of the Extended Binary Coded Decimal Interchange Code representing characters, letters, punctuation marks in memory.
4. Convert numbers from/to any of the following bases, binary, octal, decimal, hexadecimal. Do addition of 2 digit numbers in any base.
5. Explain the different techniques used in printers, readers, and card punches.
6. Explain the differences between magnetic tape, disk, drum, and mass storage devices.
7. Understand the concepts and use of teleprocessing.
8. Describe the functioning of a simple CPU.

PERFORMANCE OBJECTIVES

1. Draw from memory the diagram of a typical computer system showing the five major components, the connections between them and state the functions of each of the five components. All names, connections, and functions must be correct.

PERFORMANCE OBJECTIVES (continued)

2. Given a chart of the EBCDIC characters and their bit configuarations, correctly match five bit configurations with their character representations.

3. Given a list of ten terms and another list of definitions, correctly match them by memory.

4. Given two numbers in each base, you will convert them to each of the three other bases (24 conversions). Eighteen of 24 must be correct.

5. Add two pairs of 2-digit numbers in each base (except decimal). Four of the six additions must be correct.

6. Explain in writing the operation of the main feature of each of the devices discussed in this section. (18 devices) 14 must be correct.

7. Rank the four types of magnetic-storage devices according to storage capacity, speed of access to data, data transfer rates, and cost per byte. No more than four rankings may be wrong. Compare the devices for method of data access and method of file identification.

8. Write definitions for terms used in this section.

9. Given a list of operation codes and what each does (for a very simple hypothetical computer) and a short (5-10 instructions) program in machine language, follow the program the way the computer would in order to arrive at the same result a real CPU would.

LEARNING ACTIVITIES

1. Participate in a discussion with the instructor concerning the organization of the components of the hardware computer system. If you have not already done so, you will take a tour through the computer room at Ivy Tech-Indianapolis.

2. Fill out a worksheet on names and functions of the computer system.

3. You will work with an EBCDIC chart and look up bit configurations for letters and special characters and given special letters and characters will look up the bit configurations for them.

4. Participate in a discussion on the functions of memory, what kinds of information are stored there, how the memory is organized. Included in the discussion should be information about how information is transferred into memory and how it is written from memory in order to save it or convert it into forms readable by human beings.

5. Read the chapter in the text concerning computer memory.

6. Participate in instructor's discussion on number systems.

7. Read chapters in text on number systems.

LEARNING ACTIVITIES (continued)

8. Fill out worksheet on conversions from one base to another, and additions.
9. Participate in the instructor's presentations on how readers, punches, and printers work.
10. Read chapter in text on these devices.
11. Fill out worksheet covering the operation of these devices.
12. Read the section in the text on magnetic storage devices.
13. Participate in the instructors presentations on storage devices.
14. Fill out a worksheet comparing the devices.
15. Participate in the instructor's discussion of teleprocessing. Subjects to include terminals, lines, transmission control units, and applications.
16. Read chapter in text concerning teleprocessing.
17. Fill out worksheet matching terms with definitions.
18. Participate in the instructors presentations on the operation of a simple hypothetical CPU.
19. Fill out a worksheet on the operation of the instructions - ADD, SUBTRACT, COMPARE, BRANCH, MOVE, READ, WRITE.
20. Read handout on operation of hypothetical CPU.
21. Read chapter in text on CPU.

MATERIALS & MEDIA

1. Worksheet containing components of the hardware system.
2. Worksheet for matching function with components.
3. Extended Binary Coded Decimal Interchange Code chart.
4. Worksheets on conversions and addition.
5. Worksheets on readers, punches, and printers.
6. Transparencies or slides showing mechanisms.
7. Transparencies of the devices.
8. Worksheet on device comparisons and attributes.
9. Sample tape reel and disk pack.

MATERIALS & MEDIA (continued)

10. Worksheet with terms and definitions.

11. Handout on operation of hypothetical CPU.

12. Worksheet on instructions.

13. Videotape of CPU operation.

TERMINOLOGY

central processing unit (abbreviated CPU)
main storage or memory
disk drive
tape drive
magnetic disk
magnetic tape
reader
punch
console typewriter
instructions
interruption
telecommunications lines
terminals
control signals
basic addressable unit
address
bit
byte
read
write
character
special character
non-printable character
load
instruction operation code
number base
digit
binary
octal
hexadecimal
decimal
conversion
radix
printers
- serial
- line
- page
- chain
- drum
- wire matrix
- ball
- ink-jet matrix
- daisy wheel
- electro-graphic

TERMINOLOGY (continued)

readers
  magnetic ink character recognition (MICR)
  optical character recognition
  optical mark scanner
  voice recognition units
types of punched card readers
  brush reader
  photo cell reader
  column reader
  row reader
magnetic tape
magnetic disk
magnetic drum
fixed head disk
head per track disk
head
track
cylinder
file label
volume table of contents (VTOC)
random access
sequential access
mass storage device
floppy disk
teleprocessing
telecommunications
terminal
intelligent terminal
transmission speed
Baud
transmission control unit
modern (data set)
analog
digital
response time
transmission line
half duplex, full duplex
applications
electronic fund, transfer
reservations
information retrieval
time sharing
CPU
arithmetic logic unit (ALU)
control unit (CU)
instruction phase
execution phase
operation code
operand
operand address
add
subtract
compare
move
branch

SELF-TEST

MODULE 01-2 COMPUTER HARDWARE

1. Draw from memory a diagram of a typical computer system showing the five major components, and the connections between the components and state the function of each of the five components?

2. Define the following terms:

   CPU
   Control unit
   Core
   Secondary storage
   Address
   Main storage
   Arithmetic/logic unit
   Block
   Binary
   Random access

3. Perform the following:

   The expanded form of the octal number 1372 is _____

   The binary equivalent of the octal number 1372 is _____

   The octal equivalent of the binary number 11011101011_2 is _____

4. The EBCDIC for the characters A, 3, 0 (zero), and S are?

5. Determine whether each of the devices and/or media listed below are used for input only, output only, input/output, or an off-line device.

   card readers
   card punches
   card reader-punch
   printer
   teletypewriter
   paper-tape reader
   paper-tape punch
   magnetic tape
   console
   optical scanners
   graphical display devices
   magnetic-ink character readers
   paper tape-to-magnetic tape converter
   key-to-tape devices
   film devices
   audio devices

DOMAIN 01 DATA PROCESSING FUNDAMENTALS

MODULE NAME 01-3 COMPUTER PROGRAMMING

PURPOSE OF MODULE

Computer hardware is completely worthless unless programs are written to direct the hardware to do some useful work. In order to understand computer data processing, you must have some concept of what a program is and how it is produced. This module discusses both of these topics.

RATIONALE

An understanding of the various processes by which the computer is made to follow the directions of the programmer is vital to the process of debugging programs. When a program is done correctly, there is little need to understand the exact process involved. However, when something goes wrong, it is sometimes difficult to understand how to fix the "bug" without some knowledge of the processes of compilation, assembly, interpretation, and generation.

COMPETENCIES

1. Understand the steps in the programming process and the tools programs use in each step.
2. Be able to read and follow a flowchart.
3. Be able to follow the directions to solve a problem when the directions are stated in decision table form.
4. Select best language for given types of applications.
5. Explain each of the methods of language processing.

PERFORMANCE OBJECTIVES

1. From memory, correctly match terms with definitions from a list.
2. Define in writing: computer program, assembler, compiler, generator, and interpreter plus other terms in this section.
3. State the differences between machine oriented languages and higher level languages.
4. From memory correctly draw a diagram of the compilation/execution process.
5. Given two simple flowcharts, with three or four sets of input for each, you will correctly follow the directions in the flowchart and determine the correct output from each.

PERFORMANCE OBJECTIVES (continued)

6. Given the outline of the eight blocks common to program flowcharts, describe or match from memory the use of each one. Seven out of eight must be correct.

7. Given a decision table with four conditions and five actions and four sets of input data, you will correctly determine which actions are to be performed for three of the four sets of input data.

8. Given brief descriptions of eight different applications, choose for each the best language for coding a solution. The choices should be from the list: COBOL, FORTRAN, RPG, Assembler. Six of the eight must be correct. (The applications should be described sufficiently so the choice of language is clear-cut).

9. Given sample programs in each of the languages listed above, correctly identify which language is used.

10. Given a list of language processor types, the learner will match them with a list of processor attributes. (See chart 1).

LEARNING ACTIVITIES

1. Participate in the instructor's presentation(s) which will include the following subject content: program development process, languages (both machine oriented and higher level), compilers, assemblers, interpreters, and generators.

2. Read introductory chapter in text on programming.

3. Fill out a worksheet covering process and definitions.

4. Read chapter in text on flowcharting.

5. Work with self-study booklet on flowcharting.

6. Read section in text on decision tables.

7. Work with self-study booklet on decision tables.

8. Read the sections in the text on programming languages.

9. Participate in the instructors presentation on programming languages, content to include business languages, scientific languages, report generators, assemblers, interactive languages, assembler languages. The same program coded in each of these languages should be presented.

10. Read section in text on compilers and translators.

11. Participate in instructor's presentation on language processors. Subject matter is to include compilers, assemblers, interpreters, generators, cross-assemblers, cross-compilers, source code, object code, diagnostics, machine independence.

MATERIALS & MEDIA

1. Worksheet on general steps of programming process.
2. Worksheet on language/compiler/assembler/interpreter/generator relationships.
3. Self-study booklet on flowcharting.
4. Self-study booklet on decision tables.
5. Sample programs written in each of the primary languages discussed.

TERMINOLOGY

program
programming
logic flowchart
decision table
machine language
higher level language
compiler
assembler
interpreter
generator
debugging
testing
playing computer
walk-through
terminal block
process block
decision block
I/O block
subroutine block
onpage connector
offpage connector
modification block
action stub
action entry
condition stub
condition entry
don't-care condition
else rule
rules
complete decision table
limited-entry decision table
extended-entry decision table
COBOL
FORTRAN
RPG
cross-compiler
cross-assembler
macro-processor
source code
object code

CHART 1

ATTRIBUTES	COMPILER	IN-CORE COMPILER	CROSS-COMPILER	ASSEMBLER	CROSS-ASSEMBLER	MACRO PROCESSOR	GENERATOR	INTERPRETER
translates source to object	Y	Y	Y	Y	Y	Y	?	N
makes reusable copy of object	Y	N	Y	Y	Y	Y	Y	NA
can run object code on different computer	N	N	Y	N	Y	N	N	NA
# of object instructions per source instruction	*	*	*	1	1	*	?	NA
object code may be other than machine code	Y	N	N	N	N	Y	N	NA
logic of object source pgm somewhat limited	N	N	N	N	N	N	Y	N

SELF-TEST

MODULE 01-3 COMPUTER PROGRAMMING

1. Construct a program flowchart from the following COBOL PROCEDURE DIVISION instruction:

```
PROCEDURE DIVISION

BEGIN.
     OPEN INPUT IN-FILE, OUTPUT OUT-FILE.
     MOVE ZEROES TO TOTAL.
CALC-RTN.
     READ IN-FILE AT END GO TO EXIT.
     IF AMOUNT 100 MULTIPLY AMOUNT
     BY .05 GIVING DISCOUNT ELSE
     MULTIPLY AMOUNT BY .04 GIVING
     DISCOUNT.
     ADD DISCOUNT TO TOTAL.
     SUBTRACT DISCOUNT FROM AMOUNT
     GIVING NET.
     MOVE ACCOUNT-NO TO ACCT-NO-OUT.
     MOVE AMOUNT TO AMOUNT-OUT.
     MOVE NET TO NET-OUT.
     WRITE PRINT-OUT.
     GO TO START.
EXIT. MOVE TOTAL TO TOTAL-OUT.
     WRITE PRINT-OUT-1.
     DISPLAY 'END OF JOB'.
     CLOSE IN-FILE, OUT-FILE.
     STOP RUN.
```

2. What are the differences between machine oriented languages and higher level languages?

3. Write a Fortran program to calculate the amount for P dollars invested at R per cent compoiunded C times per year for from 1 to N years. P, R, C, and N are to be input at the time the program is executed. You may assume that P will not exceed 999.99 dollars, R will not exceed 0.050, C will not exceed 12, and N will not exceed 5. The formula to determine amount is

$$A = P(1 + R/C)^{cn}$$

4. Name and describe each of the parts of the decision table given below.

(a)	(d)
(b)	(e)
(c)	(f)

APPENDIX F

STUDENT PROGRESS CHECKLIST EXAMPLES

COMPETENCY CERTIFICATION RECORD

JOB TITLE: COMPUTER PROGRAMMER (Entry)

TO THE EMPLOYER:

This occupational readiness record is an inventory of the education/training program and a measure of the level of proficiency attained in job tasks by the individual student. It is recognized that persons working at the specified technical level will function with direction and assistance from superiors. As a part of the training the graduate has learned to expect appropriate instruction and supervision with each assigned task. Furthermore, the graduate understands that he/she lacks the authority and training to perform certain functions and operations. He/she will expect and seek, supervision, assistance and direction where appropriate. Note that the job tasks as identified are basic to the next higher or more sophisticated job level. Work experience, training and further education may qualify the graduate for more complicated tasks, a new job title and higher pay.

RATING SCALE:

Level 1: Proficient—understands operating principles and performs all parts of the task with exceptional ability, meets above minimum demands for speed and accuracy.

Level 2: Moderate Proficiency—requires assistance on some parts, but performs that procedure with speed and accuracy.

Level 3: Entry Level Proficiency—performs task at job entry, but requires instruction and supervision to do most parts of the job. Knows basic facts about the job.

Level 4: Cannot perform this competency satisfactorily for participation in a work environment.

Level 5: Competency accomplished by test out procdure. Student had previous training or experience.

Student's Name: _____

MODULE NO.	MODULE NAME	HOURS	RATING	INSTRUCTOR

APPENDIX G

TASK ANALYSIS GUIDE

TASK ANALYSIS GUIDE

I. Task Statement:

Transform Code to Machine readable form.

II. Task Performance Cues:

Given a coded source program
Perform as part of requirement for writing a program.

III. Task Performance Procedures:

A. When a decision must be made, indicate alternatives as "Yes-No" answers to questions.

B. List performance steps by most frequently occurring sequence.

TASK ELEMENTS	Decisions		Go To Step	Tools, References, Work Aids
	Yes	No		
1. Do I have a coded source program?	2	EOT		
2. Am I responsible for transforming the source program to machine readable form?	3	6		
3. Do I have to schedule a machine?	4	5		
4. Schedule machine.			5	
5. Prepare machine readable source program.			EOT	
6. Send coded source program to data entry for preparation.			EOT	

TASK ANALYSIS GUIDE

I. Task Statement:

Code source programs from program specifications.

II. Task Performance Cues:

Given problem statement

III. Task Performance Procedures:

A. When a decision must be made, indicate alternatives as "Yes-No" answers to questions.

B. List performance steps by most frequently occurring sequence.

TASK ELEMENTS	Decisions		Go To Step	Tools, References, Work Aids
	Yes	No		
1. Do you have a graphic flowchart for the problem statement?	2	7		
2. Do you have the necessary supplies?	3	9		
2a. Do you have a choice of language for coding?	10	3		
3. Do you know language characteristics?	4	12		
4. Do you know language rules?	5	13		
5. Do you know how to code program using selected language?	6	14		
6. Code program			EOT	
7. Do you know how to prepare a graphic flowchart?	8	15		
8. Prepare a graphic flowchart.			2	
9. Obtain the following supplies: pencil, coding sheet			2a	
10. Do you know which language is most appropriate?	11	16		
11. Select language for coding.			- 3	

TASK ELEMENTS	Decisions		Go To Step	Tools, References, Work Aids
	Yes	No		
12. Review resource on how to recognize language characteristics.			4	
13. Review resource on how to recognize rules.			5	
14. Review method on coding.			6	
15. Review how to prepare graphic flowcharts.			7	
16. Check with supervisor as which language to use.			11	

Social Science Department
IVTC

TASK ANALYSIS GUIDE

I. Task Statement: DEMONSTRATE EFFECTIVE LISTENING TECHNIQUES.

II. Task Performance Cues: GIVEN: the ability to take in information, either through auditory sounds, sign language, or lip-reading.

III. Task Performance Procedures:

A. When a decision must be made, indicate alternatives as "Yes-No" answers to questions.

B. List performance steps by most frequently occurring sequence.

TASK ELEMENTS	Decisions		Go To	Tools, References,
	Yes	No	Step	Work Aids
1. Can I take in information?	2	EOT		
2. Do I know how to translate into my own words the ideas and feelings of another person?	3	7		
3. Do I know how to condense what the speaker said in the speaker's own words?	4	8		
4. Do I know how to ask the speaker to explain or elaborate on parts of the content to check on my understanding of it?	5	9		
5. Do I understand how to elicit feedback from the speaker, listening carefully to it, and then take action to modify my behavior?	6	10		
6. Do I know how to describe someone's feelings to demonstrate my understanding of how he feels?	12	11		

TASK ELEMENTS	Decisions		Go To	Tools, References,
	Yes	No	Step	Work Aids
7. Learn how to paraphrase someone else's words by practicing this technique in television viewing & conversation. Begin by putting into your own words what TV newscasters are saying. Also helpful would be watching a news program captioned for the hearing-impaired--the captions are paraphrasals. Finally, practice this technique in conversations with co-workers in data-processing situations.			3	
8. Learn how to summarize what a speaker is saying by practicing this technique with reading and in conversation. Begin by examining chapter summaries in books. Then, practice summarizing some printed materials. Finally, practice summarizing what people say to you --both in social and work-related situations.			4	
9. Learn how to ask content questions by practicing this technique in conversation. Begin by asking a friend to explain a difficult task, idea, or game to you. As he explains, interrupt him at any point where you are confused, and ask him to clarify the specific points you don't understand. Finally, ask your supervisor or a co-worker to explain an unfamiliar programming idea to you; practice asking content questions during the explanation.			5	
10. Learn how to ask for and receive feedback by practicing this technique in conversation. Begin by asking friends or relatives to give you <u>specific</u> feedback--both strengths and weaknesses--in some area you are concerned about, such as your choice of clothing, your performance on a musical instrument, etc Then, ask your supervisor or co-worker to give you <u>specific</u> feedback regarding some work you have done.			6	

TASK ELEMENTS	Decisions		Go To	Tools, References,
	Yes	No	Step	Work Aids
11. Learn how to reflect someone else's feelings by practicing this technique in conversation. Begin by determining as best you can how someone is feeling during a conversation. Then, make a statement that reflects that you understand how he feels, such as, "You really sound annoyed," or "You sound as if you are really feeling thrilled."			12	
12. Apply effective listening techniques in data-processing situations.			EOT	